Fishery Data Series No. 11-43

Sonar Estimation of Salmon Passage in the Yukon River Near Pilot Station, 2007

by

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and

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October 2011

Alaska Department of Fish and Game **Divisions of Sport Fish and Commercial Fisheries**

Symbols and Abbreviations

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Weights and measures (metric)

centimeter	cm
deciliter	dL
gram	g
hectare	ha
kilogram	kg
kilometer	km
liter	L
meter	m
milliliter	mL
millimeter	mm

Weights and measures (English)

cubic feet per second	ft^3/s
foot	ft
gallon	gal
inch	in
mile	mi
nautical mile	nmi
ounce	oz
pound	lb
quart	qt
yard	yd

Time and temperature

day	d
degrees Celsius	°C
degrees Fahrenheit	°F
degrees kelvin	K
hour	h
minute	min
second	s

Physics and chemistry

all atomic symbols	
alternating current	AC
ampere	A
calorie	cal
direct current	DC
hertz	Hz
horsepower	hp
hydrogen ion activity (negative log of)	pH
parts per million	ppm
parts per thousand	ppt, ‰
volts	V
watts	W

General

Alaska Administrative Code	AAC
all commonly accepted abbreviations	e.g., Mr., Mrs., AM, PM, etc.
all commonly accepted professional titles	e.g., Dr., Ph.D., R.N., etc.
at	@
compass directions:	
east	E
north	N
south	S
west	W
copyright	©
corporate suffixes:	
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
District of Columbia	D.C.
et alii (and others)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.
Federal Information Code	FIC
id est (that is)	i.e.
latitude or longitude	lat. or long.
monetary symbols (U.S.)	$, ¢
months (tables and figures): first three letters	Jan,...,Dec
registered trademark	®
trademark	™
United States (adjective)	U.S.
United States of America (noun)	USA
U.S.C.	United States Code
U.S. state	use two-letter abbreviations (e.g., AK, WA)

Mathematics, statistics

all standard mathematical signs, symbols and abbreviations	
alternate hypothesis	H_A
base of natural logarithm	*e*
catch per unit effort	CPUE
coefficient of variation	CV
common test statistics	(F, t, χ^2, etc.)
confidence interval	CI
correlation coefficient (multiple)	R
correlation coefficient (simple)	r
covariance	cov
degree (angular)	°
degrees of freedom	df
expected value	*E*
greater than	>
greater than or equal to	≥
harvest per unit effort	HPUE
less than	<
less than or equal to	≤
logarithm (natural)	ln
logarithm (base 10)	log
logarithm (specify base)	$log_{2,}$ etc.
minute (angular)	'
not significant	NS
null hypothesis	H_O
percent	%
probability	P
probability of a type I error (rejection of the null hypothesis when true)	α
probability of a type II error (acceptance of the null hypothesis when false)	β
second (angular)	"
standard deviation	SD
standard error	SE
variance	
population	Var
sample	var

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ABSTRACT

The Pilot Station sonar project has provided daily passage estimates for Chinook *Oncorhynchus tshawytscha*, chum *O. keta*, and coho salmon *O. kisutch* for most years since 1986. Fish passage estimates for each species were generated in 2007 through a two-component process: (1) estimation of total fish passage with 120 kHz split-beam sonar and a Dual Frequency Identification Sonar[1] (DIDSON), and (2) apportionment to species by sampling with a suite of gillnets of various mesh sizes. An estimated 3,866,753 fish passed through the sonar sampling area between June 2 and August 31; 30.6% along the right bank and 69.3% (season average) along the left bank. Included were 90,184±17,621 large Chinook salmon (>655 mm METF); 35,369±9,795 small Chinook salmon (≤655 mm METF); 1,726,885±88,331 summer chum salmon; and 684,011±47,445 fall chum salmon.

Key words: Yukon River, Chinook, *Oncorhynchus tshawytscha*, chum, *Oncorhynchus keta*, hydroacoustic, riverine, sonar, run strength, species apportionment, net selectivity, DIDSON

INTRODUCTION

BACKGROUND

Within Alaska, three species of Pacific salmon (Chinook salmon *Oncorhynchus tshawytscha*, coho salmon *O. kisutch*, and chum salmon *O. keta*) are managed inseason for harvest by commercial, sport, and subsistence fisheries over 2,200 km of the Yukon River, as well as to meet treaty commitments made under the U.S./Canada Yukon River Salmon Agreement. The diversity and number of fish stocks, combined with the geographic range of user groups, adds complexity to management decisions. Escapement estimates and run-strength indices are generated by various projects along the river, providing stock-specific abundance and timing information; however, much of this information is obtained after the fish have become unavailable to the fisheries. Timely indices of run strength are provided by gillnet test fisheries conducted in the lower Yukon River, but the functional relationship between catch per unit effort (CPUE) and actual abundance is confounded by varying migration patterns through the multi-channel environment, gear selectivity, and changes in net site characteristics.

The Pilot Station sonar project has provided daily salmon passage estimates, run timing and biological information to fisheries managers for most years since 1986. The estimates from this project complement information obtained from other sources. Located in a single-channel environment at river km 197 near Pilot Station, the project is far enough upriver to avoid the wide, multiple channels of the Yukon River Delta. Because salmon migrate from the river mouth to the sonar site in 2 to 3 days, the project provides timely abundance information to managers of downstream fisheries (Figure 1). The Andreafsky River is the only major salmon spawning tributary downstream of the sonar site (Figure 2), therefore the majority of migrating salmon in the Yukon River pass the sonar project on their way to the spawning grounds.

The Alaska Department of Fish and Game's (ADF&G) primary role is to manage for sustained yield under Article VIII of the Alaska Constitution, but Alaska is also obligated to manage Yukon River salmon stocks according to precautionary, abundance-based harvest-sharing principals set forth in the Yukon River Salmon Agreement. The goal of bi-national, coordinated management of Chinook and chum salmon stocks is to meet escapement requirements that will ensure sufficient fish availability for sustained harvests in both the United States and Canada in the future. Furthermore, managers follow guidelines specified in state regulations as

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[1] Product names used in this report are included for scientific completeness, but do not constitute a product endorsement.

management plans for Yukon River Chinook, summer chum, fall chum, and coho salmon. Accurate daily salmon abundance estimates not only help managers regulate fishing inseason to meet harvest and escapement objectives, they are also used postseason to determine whether treaty obligations were met and to judge effects of management actions.

The project uses a combination of fixed-location split-beam sonar and Dual Frequency Identification Sonar (DIDSON) to estimate the daily upstream passage of fish. A series of gillnets with different mesh sizes are drifted through the acoustic sampling areas to apportion the passage estimates to species. Species apportionment methodology continues to be refined. In 2004 the selectivity curves for salmon species were updated in an attempt to more accurately estimate abundance and proportions (Bromaghin 2004).

Locations in this report are referenced by the proximate bank of the Yukon River, relative to a downstream perspective. At the sonar site the left bank is south of the right bank. Both the City of Pilot Station and the ADF&G sonar camp are located on the right bank.

The Yukon River, at the sonar site, is approximately 1,000 m wide between the left and right bank transducers (Figure 3). The left bank substrate, composed of silt and fine sand, drops off gradually at a vertical angle of approximately 2° to 4°. The right bank has a stable, rocky bottom that drops off uniformly to the thalweg at a vertical angle of approximately 10°. The thalweg is approximately 25 m deep and is located approximately 200 m offshore of the right bank. Water velocity, as measured with acoustic Doppler profiling, ranges up to 2 m/sec in offshore portions of the water column. River height, as observed from 1995 to 2007 at the United States Geological Survey (USGS) gage station located downstream of the project, ranged from a maximum of 32.7 ft to a minimum of 13.5 ft during the months of June, July, and August (Figure 4).

Prior to 1993, ADF&G used dual-beam sonar equipment that operated at 420 kHz. In 1993, ADF&G changed the existing sonar equipment to operate at a frequency of 120 kHz to allow greater ensonification range and to minimize signal loss. The newly configured equipment's performance was verified using standard acoustic targets in the field in 1993. Use of lower frequency equipment increased fish detection at long range. The current sonar deployment counts operate out to a range of 150 m on the right bank, and 250–300 m on the left bank. Given the distribution of observed targets, and the current speed in the middle of the river, it is likely that the majority of fish passing the site are within the ensonification range.

Up until 1995, ADF&G attempted to identify direction of travel of detected targets by aiming the acoustic beam at an upstream or downstream angle relative to fish travel. This technique was discontinued in 1995. Significant enhancements that year included implementation of an aiming strategy designed to consistently maximize fish detection. Because of this and subsequent changes in counting methodology, data collected from 1995 to 2007 are not directly comparable to previous years. In 2001, the equipment was changed from the dual-beam to the current split-beam sonar system. This technology allows better testing of assumptions about direction of travel and vertical distribution.

In 2004, the selectivity model used in species apportionment was refined through biometric review and analysis of historical catch data from the project test fishery. The model providing the best overall fit to the data was a Pearson model with a tangle parameter. Species proportions and passage estimates reported here were generated with this apportionment model, and are comparable with estimates from 1995 to the present, as historical estimates have been re-generated using the most current model and methodology (Hamazaki[2]; Bromaghin 2004).

Early in the 2005 season, the Yukon River experienced high water levels and erosion in the bottom profile that, along with a combination of changes in fish movement and distribution, affected detection of fish with the split-beam sonar within 20 m of shore on the left bank. On June 19, 2005 a DIDSON imaging sonar was deployed in this area to verify nearshore fish detection. With its wider beam angle, the DIDSON system was able to detect fish passage within 20 m despite high water levels and problematic erosion nearshore, and was operated for the remainder of the season, supplanting split-beam counts in this section of nearshore region.

In 2006 and 2007, the DIDSON was integrated into the sampling routine on left bank for the whole season, operating side-by-side with the split-beam sonar. The DIDSON sampled the first 20 m of the nearshore stratum; the remainder of the 250 m range was sampled by the split-beam.

GOALS AND OBJECTIVES

The primary goal of this project is to accurately estimate daily fish passage, by species, during upstream migration past the sonar site. Although full-river ensonification is not achieved, the estimate likely encompasses the majority of the migrating fish. Project objectives were to:

1. Provide managers with timely estimates, and associated confidence intervals of daily and seasonal passage of adult Chinook, chum, and coho salmon;
2. Collect biological data from all fish captured in the test fishery, including species, sex, length, and scales as appropriate;
3. Assist in the collection of Chinook and chum salmon tissue samples for separate genetic stock identification projects; and
4. Collect water temperature data representative of the ensonified areas of the river.

METHODS

Estimates of upstream migration of targeted fish species are produced from a combination of independently generated estimates of fish movements past the sonar site using hydroacoustic equipment, and species proportions based upon the results of drift gillnetting in the same area (Figure 5).

HYDROACOUSTIC DATA ACQUISITION

Equipment

Left bank sonar equipment included:

1. A Hydroacoustic Technology Inc (HTI) Model 244 echo sounder configured to transmit and receive at 120 kHz, controlled via Digital Echo Processing (DEP) software installed on a laptop computer;
2. An HTI 120 kHz split-beam transducer with a 2.8°x10° nominal beam width;
3. Three 250 ft HTI split-beam transducer cables connecting the sounder to the transducer;
4. An HTI Model 405 digital chart recorder coupled with a Panasonic KXP 3624 dot matrix printer;

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[2] Hamazaki, T. *Unpublished*. Comparison of net selectivity models for Yukon River Pilot Station sonar test fishery. Alaska Department of Fish and Game, Division of Commercial Fisheries, Anchorage.

5. A Hewlett-Packard (HP) Model 54501A digital storage oscilloscope;
6. A DIDSON-LR (Long Range) unit (12ºx29º approximate beam dimension), configured to transmit and receive at 1.2 MHz, and controlled via software installed on a laptop computer; and
7. One 500 ft. DIDSON underwater cable connecting the DIDSON to the "topside breakout box" and laptop computer.

Right bank sonar equipment included:

1. An HTI Model 244 echo sounder configured to operate at 120 kHz, controlled via DEP software installed on a laptop computer;
2. An HTI split-beam 120 kHz transducer with a 6°x10° nominal beam width;
3. Three 250 ft (228.6 m combined length) HTI split-beam cables connecting the sounder to the transducer; and
4. An HTI Model 405 digital chart recorder coupled with Panasonic KXP 3624 dot matrix printer.

Each system configuration of sounder, transducer, and cable was calibrated by the manufacturer prior to the field season. Transducers were mounted on metal tripods and remotely aimed with HTI model 662H dual-axis rotators. Rotator movements were controlled with HTI model 660-2 rotator controllers with position feedback to the nearest 0.1°. Gasoline generators (3000 W) supplied 120 VAC power. The split-beam sonar signal was processed by the digital chart recorders, printed to paper charts, and hand-marked. DIDSON data was saved onto the laptops and processed daily via electronic echograms.

Equipment Settings, Thresholds, Data Storage

The split-beam echo sounders used a 40 log(R) time-varied gain (TVG) and 0.4 ms transmit pulse duration during all sampling activities (Table 1). The receiver bandwidth was automatically determined by the equipment based on the transmit pulse duration. Pulse repetition rates were set below the maximum allowed by range to avoid overloading printer buffers. On the left bank, the nearshore stratum pulse repetition rate was set to 5 pings per second (pps), the midshore stratum was set at 4 pps and the offshore stratum was set at 2.5 pps. The pulse repetition rate for the right bank nearshore was set at 5 pps and the offshore stratum was set at 4 pps.

For the split-beam system, echoes were digitized by chart recorders, and then printed on wide carriage, continuous-feed paper using dot matrix printers. Four printer thresholds, corresponding to degrees of gray-line, were set for all strata in approximately 3 dB increments. The lowest sampling threshold was set at approximately 40 dB, or about 12 dB lower than the theoretical on-axis target strength of a chum salmon of minimal length (450 mm) calculated using Love's equation (Love 1977). Lowering the threshold by 12 dB allows for detection across the nominal beam width (6 dB) and variability (~6 dB) induced by fish aspect and noise corruption. Transmit power was adjusted as necessary to compensate for environmentally induced signal loss. Threshold levels (in mV) were recorded and converted to target strength, TS_{dB}, as follows:

$$TS_{dB} = 20 \cdot \log\left(\frac{T_{mV}}{1000\,mV}\right) - \left(SL + G_S + G_R\right). \tag{1}$$

Where:

> T_{mV} is the chart recorder threshold in mV, SL is the transmitted source level in dB, G_S is the through-system gain, and
>
> G_R is the receiver gain.

The DIDSON (Table 2) operated at an average rate of 8 frames/s with a starting range of 0.83 m and an end range of 20.84 m, in high-frequency mode (1.2 MHz). Files were recorded onto the laptop and were processed using electronic echograms, where operators could change intensity and threshold to increase visibility of targets on screen.

Aiming

The transducers were always positioned and aimed to maximize fish detection. With the transducer located in the area with the best bottom profile, the beam was oriented approximately perpendicular to the current so that migrating fish would present the largest possible reflective surface. Since many fish travel close to the substrate, the maximum response angle of the beam was oriented along the river bottom through as much of the range as possible.

Fluctuating water levels required repositioning of the transducers, and subsequent re-aiming of the beams. To establish an optimal aim, the transducer was panned horizontally upstream and downstream approximately 15° off perpendicular in 2° increments. At each increment, the vertical tilt was adjusted to obtain the best possible bottom picture. The left bank transducers were re-aimed more often to compensate for the dynamic bottom conditions on that side of the river. Once an optimal aim was obtained, the rotator settings were documented and chart printouts of the new aim were posted for visual reference. All operators were trained to first aim to established pan and tilt settings, then to refine that aim to match the substrate pattern on the current chart printout with those of reference chart samples.

Sampling Procedures

Transducers were deployed on both the left bank and the right bank in an area where the river is approximately 1,000 m wide. The right bank transducer was positioned approximately 3 m from shore, adjusting the aim between 2 strata (S1: 0–50 m and S2: 50–150 m). The left bank split-beam transducer was deployed approximately 5 m from the shoreline and utilized 3 distinct aims to sample a nearshore stratum (S3, 0–50 m), a midshore stratum (S4: 50–150 m), and an offshore stratum (S5: 150–250 m). The DIDSON unit was deployed within 2 m of the split-beam transducer and ensonified the first 2 sectors of the nearshore stratum (0–20 m) (Figure 6). Because the DIDSON sonar’s wider beam angle is ideal for the less linear nature of the eroded left bank nearshore, it is assumed that it will detect fish targets better than the split-beam which is narrower in the extreme nearshore. Therefore, when aiming the split-beam for the nearshore stratum from 0 to 50 m, when necessary for best detection, the aim is optimized for the 20 to 50 m portion of the stratum, which is not ensonified by the DIDSON. In this way, the sonar systems are used in concert to maximize detection for the entire nearshore stratum on left bank. The counts from the 2 systems cannot directly be compared for the 0 to 20 m nearshore, since the aiming strategy optimizes fish detection for DIDSON but not the split-beam within this range.

Throughout the season strata ranges were adjusted to provide an optimal fit to the bottom profile. The left bank transducers were occasionally relocated either upstream or downstream to compensate for the dynamic bottom profile. Transducers on each bank were repositioned either inshore or offshore as needed to compensate for changing water levels.

Acoustic sampling was conducted simultaneously on both banks during three 3-hour periods each day (Table 3). Sample periods were scheduled from 0530 to 0830, 1330 to 1630, and 2130 to 0030 hours, alternating sequentially between strata every 30 minutes. Each sampling stratum was subdivided into 5 equal range sectors, with sonar counts tallied by sector in 15-minute intervals during daily sampling periods. The DIDSON-generated sonar counts supplanted those of the split-beam for Sectors 1 and 2 of the nearshore stratum if they were higher.

Operators counted fish traces on paper echograms for the split-beam system, and on electronic echograms for the DIDSON system. Echo traces were counted as a single fish if at least 2 pings in the cluster passed the second printer threshold level (see Equipment Settings, Thresholds, Data Storage) and the targets did not resemble inert downstream objects. Groups of fish were distinguishable when the apparent direction of movement of one fish trace differed from that of an adjacent trace.

Fish traces were tallied on field data forms and entered into a Microsoft Access database. The data were checked daily for data entry or tallying errors, then processed in SAS using statistical routines developed by the regional biometrician.

All personnel were trained to distinguish between fish tracings and non-target echoes. Chart printouts and echograms were reviewed daily by either the project leader or crew leader to monitor the accuracy of the marked fish tracings and reduce individual biases. Each chart image was checked for indications of signal loss and changes in bottom reverberation markings, which could indicate either movement of the transducer or a change in bottom structure.

During most seasons, on designated days, the sonar is run continuously on both banks for a 24-hour period. Sampling is divided among strata in a sequence consistent with the regular sampling schedule. Estimates obtained from the regular 3-hour sampling period are compared with those found when the sonar runs continuously over the same day, as a simple qualitative assessment of the sampling model. Results of these comparisons are not used to adjust estimates, nor do they result in a change of the sampling protocol.

SYSTEM ANALYSES

Performance of the hydroacoustic system was routinely monitored following procedures first established in 1995 (Maxwell et al. 1997). System analyses included equipment performance checks, bottom profiles using down-looking sonar, and hydrologic measurements.

Bottom Profiles

Bottom profiles were recorded along both banks using a Lowrance LCX15MT recording fathometer with GPS capabilities to locate deployment sites with suitable linear bottom profiles. All bottom profiles were recorded and stored electronically. Inseason, the fathometer was used regularly to monitor changing bottom conditions and to watch for the formation of sandbars capable of re-routing fish to unensonified areas.

Hydrological Measurements

Water level was measured using a staff gage located slightly offshore on the right bank, in the field camp. To standardize measurements with observations from previous years, water level measurements were adjusted to the USGS Water Resources Division reference located approximately 500 m downstream of Pilot Station. The information collected from the staff gage was used inseason as a relative water height indicator, and to gather information as a backup for times when the USGS water data was unavailable.

Water temperature was recorded daily using submerged electronic data loggers affixed to the sonar pods on each bank. Temperatures were also collected during the test fishery on each bank, usually within 50 m from shore, using a mercury thermometer submerged approximately 15 cm below the water surface.

SPECIES APPORTIONMENT

Equipment and Procedures

To estimate species composition, gillnets were drifted through 3 zones (right bank, left bank nearshore, and left bank offshore) corresponding to sonar sampling strata (Figure 6). A total of 8 different mesh sizes were fished throughout the season to effectively capture all size classes of fish present and detectable by the hydroacoustic equipment (Table 4). All nets were 25 fathoms (45.7 m) long and approximately 8 m deep. All nets were constructed of Momoi MTC-50 or MT-50, shade 11, double knot multifilament nylon twine and hung “even” at a 2:1 ratio of web to corkline.

Test fishing was conducted twice daily between sonar periods, from 0900 to 1200 hours and 1700 to 2000 hours. During each sampling period, 4 different nets were drifted within each of 3 zones for a total of 24 drifts per day (Table 5). The order of drifts were 1) left bank nearshore zone, 2) right bank zone, and 3) left bank offshore zone, with a minimum of 20 minutes between drifts in the same zone. Each mesh size was fished in all 3 zones before switching to the next mesh size. The shoreward end of the left bank nearshore drift was held approximately 5 to 10 m from shore. The left bank offshore drift was approximately 65 m offshore so as not to overlap with the nearshore drift. Drifts were approximately 8 minutes in duration, but were shortened as necessary to avoid snags or to limit catches during times of high fish passage.

In the 2007 season, as part of a separate CIP-funded genetic study, an extra period of gillnetting was conducted in order to collect additional Chinook samples. The drifts were located upriver of the area sampled by the sonar, and 3 gillnet mesh sizes (8.5-, 7.5-, 6.5-inch) were used to target all size classes of Chinook salmon. All other species captured during this extra period were immediately released, and therefore not sampled.

Captured fish were identified to species and measured to the nearest one mm length. Salmon species were measured from mideye to fork of tail (METF); non-salmon species were measured from snout to fork of tail (FL). Fish species, length, and sex were recorded onto field data sheets. Each drift record included the date, sampling period, drift start and end times, mesh size, length of net, and captain’s initials.

The probability of a fish of a given species and length being captured in a net is dependent on mesh size. To remove the effect of net selectivity, the Pearson T net selectivity model is used with coefficients generated for the following species: Chinook salmon; summer and fall chum salmon; coho salmon; pink salmon *O. gorbuscha*; cisco *Coregonus sardinella*, *C. laurettae*; Humpback whitefish *C. pidschian*; and broad whitefish *C. nasus*. In addition, coefficients have also been generated for a group of other species containing: sheefish *Stenodus leucichthys*; burbot *Lota lota*; longnose sucker *Catostomus catostomus*; Dolly Varden *Salvelinus malma*;

sockeye salmon *O. nerka*; and northern pike *Esox lucius*. A detailed description of the apportionment model and the derivation of net selectivity coefficients used (listed in Appendix A) can be found in Bromaghin 2004.

Scale samples were collected from Chinook salmon, mounted on scale cards, and scale and card numbers were recorded on the test fishing data sheets. Data were transferred from data sheets into a database and processed using SAS software. Age, sex, length (ASL) data were processed, analyzed, and reported by ADF&G staff based in Anchorage (Horne-Brine et. al. 2009). Handling mortalities among the captured fish were distributed to the local community, with fish dispersal documented daily.

Genetic tissue samples from both Chinook and chum salmon were also collected for several other projects, in conjunction with the Yukon sonar project test fishing. Age, sex, and length data was cross-referenced with each tissue sample. The ADF&G Gene Conservation Laboratory (DeCovich and Templin 2009) and the USFWS Conservation Genetics Laboratory (Flannery et al. 2007) independently processed and analyzed these samples.

Chinook salmon were classified as either 'large' (>655 METF) or 'small' (≤655 METF), with small Chinook salmon serving as a proxy for one-ocean 'jacks'. Although there is some temporal overlap between the summer and fall runs of chum salmon, for the purposes of estimating passage, all chum salmon encountered through July 18 were designated as summer chum and post July 18 were designated as fall chum salmon.

ANALYTICAL METHODS

Daily estimates were produced from a multi-component process involving:

a) hydroacoustic estimates of all fish targets passing the site, without regard to species;
b) species composition derived from test fishing results and applied to the undifferentiated hydroacoustic estimates; and
c) traditional CPUE estimates, used as a separate index by the managers and calculated on a subset of the test fishing data.

Sparse and Missing Data

Test fishing was not conducted during commercial fishery openings and occasionally, during periods of low salmon passage, catches were too sparse to accurately estimate species proportions and associated error bounds. When sufficient gillnet samples were not available for a given day and zone, the data were pooled with data from one or more adjacent days by assigning the same report unit *u*.

Traditional CPUE estimates were calculated on a daily basis irrespective of catch size. In contrast, sonar passage, species composition, and species passage estimates were first calculated on the basis of report units (encompassing one or more full days of sampling in a zone), and then apportioned to daily estimates. For any test fish variable x the report unit u encompasses day(s) d, test fish period(s) p, and zone(s) z such that:

$$x_u = \sum_{d,p,z}^{u} x_{dpz} \quad (2)$$

The report unit was then also appended to the corresponding days and zones of sonar passage estimates. In effect, any unique combination of day and zone having sufficient test fish catch was also assigned a unique report unit *u*, while combinations not having sufficient catch were pooled by assigning the same report unit either across zones or days.

CPUE

Traditional CPUE measures were calculated for each day *d* and bank *b* using 2 gillnet suites *g* of specific size mesh *m*. Chinook salmon CPUE was calculated on the pooled catch *c* and effort *f* of the large mesh gillnets (7.5- and 8.5-inch); chum and coho salmon CPUE was calculated on the pooled catch and effort of the small mesh gillnets (5.25-, 5.75-, and 6.5-inch).

The duration of the j^{th} test fish drift in minutes *t* was calculated as

$$t_j = (SI_j - FO_j) + \frac{(FO_j - SO_j)}{2} + \frac{(FI_j - SI_j)}{2}, \tag{3}$$

where *SO* is the time the net is initially set out, *FO* is the time the net is fully set out, *SI* is the time the net starts back in, and *FI* is the time the net is fully retrieved in.

The total fishing effort (in fathom-hours) for each day, bank, and gillnet suite was calculated as

$$f_{dbg} = \sum_g \frac{25 \cdot t_{dbg}}{60}, \tag{4}$$

since all nets were 25 fathoms (45.7 m) in length. CPUE estimates (in catch per fathom-hour) for each species *i* were made daily for the right and left banks as

$$CPUE_{dbi} = \frac{\sum_g c_{dbig}}{f_{dbg}}. \tag{5}$$

Species Composition

Test fishing drifts were made at stations in each of 3 zones (1, 2, and 3). Zone 1 consisted of the entire counting range on the right bank, zone 2 was from approximately 0–50 m on the left bank, and zone 3 was from approximately 50–250 m on the left bank. The results of the test fishing were used to generate species proportions for each zone, which were then applied to the corresponding sonar passage estimate in that zone.

To estimate species proportions, first the total effort *f* (in fathom-hours) of drift *j* with mesh size *m* during report unit *u* was calculated by multiplying the drift time *t* (calculated as in equation 3) for each mesh, drift, and reporting unit by 25 fathoms and dividing by 60 minutes per hour,

$$f_{umj} = \frac{25 \cdot t_{umj}}{60}. \tag{6}$$

Total effort for each mesh size fished was then summed over each report unit,

$$f_{um} \quad = \quad \sum_{j} f_{umj} \quad , \tag{7}$$

and the catch of species *i* of length *l* in each report period was summed across all mesh sizes,

$$c_{uil} \quad = \quad \sum_{m} c_{uilm} \quad , \tag{8}$$

for the catch of each species *i* of length *l*, the associated effort was adjusted by applying a length-based selectivity parameter *S* derived from the Pearson T net selectivity model

$$f'_{uil} \quad = \quad \sum_{m} \left(S_{ilm} \cdot f_{um} \right) \quad , \tag{9}$$

and the CPUE of the catch of each species *i* of length *l* was calculated as

$$CPUE'_{uil} = \frac{c_{uil}}{f'_{uil}} \quad . \tag{10}$$

The proportion *p* of species *i* during report unit *u* was estimated as the ratio of the CPUE for species *i* to the CPUE of all species combined,

$$\hat{p}_{ui} = \frac{\sum_{l} CPUE'_{uil}}{\sum_{i,l} CPUE'_{uil}} \quad , \tag{11}$$

and the variance was estimated from the squared differences between the proportion for each test fish period *x* for each day (*d*) within the report unit ($\hat{p}_{udxi}$), and the proportion for the report unit as a whole ($\hat{p}_{ui}$),

$$\hat{V}ar(\hat{p}_{ui}) = \frac{\sum \left(\hat{p}_{ui} - \hat{p}_{udxi} \right)^2}{n_u \cdot \left(n_u - 1 \right)} \quad , \tag{12}$$

where n_u = number of test fish sampling periods within the report unit.

Sonar Passage Estimates

Total fish passage was estimated separately for each of the same 3 zones used in the test fish species apportionment. Zone 1 consisted of the entire counting range on the right bank, corresponding to strata 1 and 2 (approximately 0–150 m). Zone 2 (left bank nearshore) consisted of the counting range corresponding to stratum 3 (approximately 0–50 m on the left bank).

Zone 3 (left bank offshore) consisted of the counting range corresponding to stratum 4 and stratum 5 (approximately 50–150 m and 150–250 m on the left bank, respectively).

Within zone 2, passage was simultaneously estimated in sectors 1 and 2 (representing approximately the first 20 m of stratum 3) using both the DIDSON and the HTI sonar. Although the DIDSON was the primary system used to generate estimates in those 2 sectors, the HTI system was also tallied since operating it in sectors 3, 4, and 5 also entailed operating in sectors 1 and 2. The counts generated by the HTI in those 2 sectors essentially served as a backup to the DIDSON in the event of a system failure or a loss of data. Since the ranges of the 2 systems did not always precisely overlap, a passage rate for the DIDSON (targets per meter-hour) was first calculated then expanded by the sector width and count time of the corresponding HTI sample to provide consistent width and count time for all sectors 1 through 5. This was done primarily as a matter of calculation convenience.

First, for sectors 1 and 2 of stratum 3, the sector widths w in meters were calculated for all samples q on day d, period p for both the DIDSON and HTI. The DIDSON unit counts over a single continuous range while the HTI subdivides this range into equal width sectors (k) 1 and 2 of stratum (s) 3. Sector widths for both systems are based on the start and end points of the range in meters referenced from the face of the transducer, such that,

$$w_{dpskq} = End_{dpskq} - Start_{dpskq} \quad . \tag{13}$$

The mean width of sectors (k) 1 and 2 of the HTI

$$w_{HTI} = \frac{\sum_{s=3} \sum_{q} w_{dpksq}}{n} \quad , \tag{14}$$

and the width of the DIDSON

$$w_{DID} = \frac{\sum_{q} w_{dpq}}{n} \tag{15}$$

samples were calculated, where n is the number of samples. The total hours h sampled with the HTI system,

$$h_{HTI} = \sum_{q} h_{dpkq} \quad , \tag{16}$$

and the DIDSON,

$$h_{DID} = \sum_{q} h_{dpq} \quad , \tag{17}$$

were summed, as were the total upstream counts *y*,

$$y_{HTI} = \sum_{q} y_{dpkq} \quad , \tag{18}$$

$$y_{DID} = \sum_{q} y_{dpq} \quad . \tag{19}$$

Passage rates (*r*) in fish per hour per meter were then calculated for both the DIDSON and the HTI systems,

$$r_{DID} = \frac{y_{DID}}{w_{DID} \cdot h_{DID}} \quad , \tag{20}$$

$$r_{HTI} = \frac{y_{HTI}}{w_{HTI} \cdot h_{HTI}} \quad . \tag{21}$$

Due to better detection capabilities at close range, and the aiming protocol described above, it was typical that the DIDSON passage rate would exceed the HTI passage rate in both sectors 1 and 2. In this case a passage estimate was generated for the time sampled by expanding the DIDSON using the HTI sector width and hours:

$$y_{dpk} = r_{DID} \cdot w_{HTI} \cdot h_{HTI} \quad . \tag{22}$$

However, in the event of a system failure or data loss using the DIDSON, the HTI estimate for those 2 sectors would be retained and used in subsequent calculations. In this case, the estimates for this time period would be considered conservative.

Total upstream fish passage *y* on day *d* during sonar period *p* in zone *z* and stratum *s* was then calculated by summing net upstream targets over all sectors *k* and samples *q*,

$$y_{dpzs} = \sum_{q} \sum_{k} y_{dpzsqk} \quad , \tag{23}$$

and the duration, in hours *h*, of the time sampled as,

$$h_{dpzs} = \sum_{q} \sum_{k} h_{dpzsqk} \quad . \tag{24}$$

The hourly passage rate r for day d, sonar period p, and zone z was computed as ratio of the sum of the estimated upstream passage in strata s to the duration (in hours) of the sample,

$$r_{dpz} = \frac{\sum_{s} y_{dpzs}}{\sum_{s} h_{dpzs}} \quad (25)$$

.

Total passage of fish in report unit u was estimated as the product of the average hourly passage rate and the total hours encompassed by the report unit,

$$\hat{y}_u = (d_2 - d_1 + 1)_u \cdot 24 \cdot \left(\frac{\sum_{d,p,z \in u} r_{dpz}}{n_u} \right) \quad (26)$$

,

where d_1 is the first day, d_2 is the last day, and n_u is the number of sonar sampling periods in report unit u.

Sonar sampling periods, each 3 hours in duration, were spaced at regular (systematic) intervals of 8 hours. Treating the systematically sampled sonar counts as a simple random sample would yield an over-estimate of the variance of the total, since sonar counts are highly auto correlated (Wolter 1985). To accommodate these data characteristics, a variance estimator based on the squared differences of successive observations, recommended by Brannian (1986) and modified from Wolter (1985), was employed;

$$\hat{V}ar(\hat{y}_u) = \left[(d_2 - d_1 + 1)_u \cdot 24\right]^2 \cdot \left[1 - \frac{h_u}{(d_2 - d_1 + 1)_u \cdot 24}\right] \cdot \frac{\sum_{p=2}^{n_u} (\hat{r}_{up} - \hat{r}_{u,p-1})^2}{2n_u(n_u - 1)} \quad (27)$$

,

where $\hat{r}_{up}$ is the estimated passage rate in reporting unit (u) for period (p), and

$$1 - \frac{h_u}{(d_2 - d_1 + 1)_u \cdot 24} \quad (28)$$

,

is the finite population correction factor.

Fish Passage by Species

The passage of species i was first estimated for each report unit u as the product of the species proportion p (Equation 11) and sonar passage y (Equation 26)

$$\hat{y}_{ui} = \hat{y}_u \cdot \hat{p}_{ui} \quad (29)$$

.

Except for the timing of sonar and gillnet sampling periods, sonar-derived estimates of total fish passage were independent of gillnet-derived estimates of species proportions. Therefore the variance of their product (daily species passage estimates y_{idz}) was estimated as the variance of the product of 2 independent random variables (Goodman 1960),

$$\hat{V}ar\left(\hat{y}_{ui}\right) = \hat{y}_u^2 \cdot \hat{V}ar\left(\hat{p}_{ui}\right) + \hat{p}_{ui}^2 \cdot \hat{V}ar\left(\hat{y}_u\right) - \hat{V}ar\left(\hat{y}_u\right) \cdot \hat{V}ar\left(\hat{p}_{ui}\right) . \tag{30}$$

Passage estimates are assumed independent between reporting units, so the variance of their sum was estimated by the sum of their variances

$$\hat{V}ar(\hat{y}_i) = \sum_u \hat{V}ar(\hat{y}_{ui}) . \tag{31}$$

Because most users of this data are interested in daily passage by species rather than passage for reporting units, the daily species passage by zone was estimated by calculating the proportion of the hourly passage rate for the day and zone to the hourly passage rate for the report unit,

$$\hat{p}_{dz} = \frac{r_{udz}}{r_u} , \tag{32}$$

and then applying the passage proportion p to the report unit estimate y,

$$\hat{y}_{dzi} = \hat{y}_{ui} \cdot \hat{p}_{dz} . \tag{33}$$

Total daily passage by species was estimated by summing over all zones,

$$\hat{y}_{di} = \sum_z \hat{y}_{dzi} . \tag{34}$$

At this stage, there are 2 potential ways of reporting total season passage, summing the estimates across days and summing across reporting units. Each can produce slightly different totals due to small rounding errors. To prevent confusion, passage estimates were summed over all zones and all days to obtain a seasonal estimate for species $y_{i,}$ (since this is how the estimates are reported)

$$\hat{y}_i = \sum_d \sum_z \hat{y}_{dzi} . \tag{35}$$

Assuming normally distributed errors, 90% confidence intervals were calculated as,

$$\hat{y}_i \pm 1.645\sqrt{\hat{V}ar(\hat{y}_i)} , \tag{36}$$

SAS® program code (Hamazaki[3]) was used to calculate CPUE, passage estimates, and estimates of variance.

RESULTS

The sonar transducer was deployed on the right bank on May 29, and test fishing began on May 30. The split-beam and DIDSON sonars were deployed on the left bank on June 1. The first full day of sampling on both banks was June 2, and the project was fully operational through August 31. Passage estimates were transmitted to fishery managers in Emmonak daily.

ENVIRONMENTAL AND HYDROLOGICAL CONDITIONS

Ice break-up on the Yukon River was sufficiently early to allow for camp set-up before June 1. The water levels in the 2007 season were uncharacteristically low near Pilot Station in early June, and then average to above average in Fall based on historical water levels from 1995 to 2007 (Figure 4).

Electronic data loggers were deployed on the left bank on June 15 and on right bank on June 26. Both loggers remained submerged until September 1, with the exception of the period from July 22 to July 27, when the right bank logger was removed from the water. Temperatures on the left and right banks recorded on the data loggers ranged from 15.1°C in mid-June to 21.8°C on July 11, with the right bank displaying a greater daily range (diel change) of temperatures (Figure 7).

TEST FISHING

Drift gillnetting resulted in the capture of 7,120 fish, including 551 Chinook salmon, 2,725 summer chum salmon, 1,595 fall chum salmon, 992 Coho salmon, and 1,257 fish of other species. Of the captured fish, 43.6% were retained as mortalities and delivered to local users to help meet subsistence needs within the nearby community (Table 6).

Daily CPUE data is reported in Appendices B1 and B2. Correlations between daily passage estimates and test fishery CPUE for Chinook salmon, summer and fall chum salmon, and coho salmon were all significant (Figure 8). The correlation coefficient for Chinook salmon was r=0.864 (P<0.001), summer chum salmon was r=0.901 (P<0.001), fall chum salmon was r=0.792 (P<0.001), and coho salmon was r=0.750 (P<0.001).

HYDROACOUSTIC ESTIMATES

An estimated 3,866,753 fish passed through the sonar sampling areas between June 2 and August 31; 1,184,544 (30.6%) along the right bank, 1,014,360 (26.2%) along the left bank nearshore, and 1,667,849 (43.1%) along the left bank offshore (Table 7). Daily total passage estimates by zone, with their associated errors, are provided in Appendix C.

On the left bank 65% of fish passage occurred within 100 m from the transducer in the summer season, but in fall, distribution increased to 75% within 100 m. In summer, 87% of fish on left bank were distributed less than 150 m from shore, and similarly in fall, 92% were distributed in the 0 to 150 m range. On the right bank the majority of fish were distributed in the nearshore stratum with approximately 78% of total fish passage occurring within 50 m in both summer and fall seasons (Figure 9).

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[3] Hamazaki, T. *Unpublished*. Comparison of net selectivity models for Yukon River Pilot Station sonar test fishery. Alaska Department of Fish and Game, Division of Commercial Fisheries, Anchorage.

In 2007, continuous 24-hour sonar periods were conducted on June 19 and August 5. The three 3-hour estimates were 3.2% lower than the 24-hour estimates on June 19, and 8.4% higher than the 24-hour estimates on August 5.

SPECIES ESTIMATES

Summer chum and Chinook salmon were first present in the river June 4, 2 days after sonar estimation began. Daily passage estimates by species for the summer and fall seasons are listed in Appendix D. Chum salmon were the most abundant species during both summer and fall seasons. Cumulative passage estimates for the season totaled 3,866,753 fish (Table 7), comprised of 1,726,885 ± 88,331 (90% C.I.) summer chum salmon passing the sonar site from June 4 through July 18 and 684,011 ± 47,445 fall chum salmon passing from July 19 through August 31. This estimate may be conservative as pulses of fall chum were reported to have entered the river after the project ended.

Chinook salmon passage estimates were comprised of 90,184 ± 17,621 fish >655 mm METF and 35,369 ± 9,795 ≤655 mm METF. Coho salmon passage estimates were 173,289 ± 20,740 as of August 31, with the project ceasing operations before the conclusion of the entire run. The estimate of pink salmon was 71,699 ± 19,755. Other species, totaling 1,085,316 fish, include whitefish, cisco, sheefish, burbot, longnose sucker, Dolly Varden, sockeye salmon, and northern pike.

Of the total passage, 4.3% of Chinook, 2.7% of summer chum, and 1.8% of fall chum salmon passed in the 0 to 20 m region of the left bank nearshore (sectors 1 and 2 of stratum 3), where the DIDSON is the primary sonar used for generating passage estimates. The daily estimates of fish passing through this region of left bank and the associated proportion, (also referred to as the DIDSON contribution), of the total passage are detailed in Appendices E1 and E2.

The first major pulse of both summer chum and Chinook salmon began approximately June 15 (Figure 10). The midpoints of the runs occurred on June 24 for Chinook salmon and June 28 for summer chum and the overall timing of the runs were average. (Figure 11, Appendices F1 and F2).

The first major pulse of fall chum salmon occurred on August 9 (Figure 12) and coincided with the midpoint of the run, also on August 9 (Figure 13 and Appendices F1 and F2). Coho salmon were first detected July 23, with 2 large pulses on August 11 and 19 (Figure 12), but as in most years, the project ends before the coho salmon run is finished, so estimates are considered conservative.

MISSING DATA

In 2007, no data periods were lost due to heavy wind or wave action. However, the left bank substrate continued to be unstable, and problems with a reverberation band were encountered. As has been observed in prior years (Maxwell and Huttunen 1998; Maxwell 2000), the reverberation band was wide enough to obscure detection of fish. For brief periods during the fall season, bank erosion upstream caused large plumes of silt to pass through the sonar sampling area, undermining optimal detection of targets. On the charts, the effect of the band was a dark region with very low signal to noise ratio in which fish targets were hard to discern, and those targets offshore of the band seemed to have lower intensity and fewer returns per target than they would in the absence of the band. Therefore, during the period of August 14 through 16, when it was believed that the reverberation band was significantly reducing target detection in approximately 20 m of stratum 4, the fish passage estimates for these days were adjusted using the rates of passage from the period before and after, as well as CPUE information from the test fishery. Though the reverberation band was present at other times during the season, project leaders were able to adjust aims and settings to minimize its effects, and estimates were comparable with CPUE from the test fishery indicating that interpolation was unnecessary. This was further verified by dragging known targets at various ranges through the sonar. As in previous years, the right bank substrate was consistently stable, so problems of this nature were not encountered on that bank.

During the summer season, 9 commercial fishing openings occurred in District 2 during one of the test fishing periods, and in fall season 5 commercial openings occurred during a test fishing period. This resulted in the cancellation of the normally scheduled test fishing and reporting units for these days were pooled with adjacent days that had 2 complete test fishery periods. There were 6 days during the 2007 season when insufficient numbers of fish were captured within one or more zones; therefore in order to estimate variance accurately, those zones were pooled with zones with sufficient catch on adjacent days. Zones that were pooled for variance estimation and the associated reason for pooling are listed with their corresponding reporting units in Table 8.

DISCUSSION

As in most seasons, the sonar was operational early enough to fully assess both the summer chum and Chinook salmon runs. However, because the project ended before the end of the fall chum and coho runs, the Pilot Station sonar estimates should be considered conservative, and do not give a complete run size index.

The water levels at season start were historically low; therefore the reverberation band was not a significant problem until the fall season when the water level increased dramatically enough to cause severe bank erosion upstream. These relatively unique water levels may also account for the somewhat unusual fish distribution seen this season. In most summer seasons, when water is typically high, fish are closer to shore, and then in fall, as the water level drops, the fish swim further offshore. This season fish were further offshore in summer, and then in fall were more closely distributed to shore than would be expected. In particular, fish densities were higher in the offshore strata of left bank than usual, and though the majority of fish appeared to pass within 250 m, it is assumed that an insignificant number of fish passed within the unensonified range. An attempt was made to verify this, however the current sonar equipment configuration did not allow for the range to be increased beyond 250 m.

The different fish distribution affected the proportions of total passage of fish in sectors 1 and 2 of the left bank nearshore, (the area counted by the DIDSON). Though proportions of passage detected nearshore on left bank with the DIDSON were significant in 2005 (32% of the Chinook, 21% of the summer chum and 9.3% of the fall chum) and in 2006 (28% of Chinook, 27% of summer chum, and 16% of fall chum Appendix G), in 2007 the DIDSON-generated passage estimates contributed much less to the total passage than previous seasons (4.3% of the Chinook, 2.7% of the summer chum and 1.8% of the fall chum total passage estimates). This indicates that the majority of fish were distributed further than 20 m from shore, and also highlights that though the DIDSON is a great complement to the sonar sampling plan on left bank, the nature of the left bank substrate, water level and fish distribution will all be factors in determining the DIDSON's relative contribution to the overall passage estimate in any given season.

Fishing activity, subsistence and commercial drift gillnetting, inside or even nearby the ensonified zone is thought to reduce the numbers of passing fish. The sonar estimation project is arranged on a staggered schedule such that test fishing does not occur during sonar monitoring. Other fishing activities do sometimes occur during sonar monitoring. Fishery managers based in

Emmonak predict, based on an estimated travel time, the arrival of large concentrations of fish in the Pilot Station area. Commercial openings are usually provided to coincide with these periods of abundance. Local subsistence fishermen often fish just below or right in front of the sonar since it is an established fishing area, and even more-so with gasoline prices near $6.00 per gallon since this area is close to home and to the buyers. The fishing activity, the boats and the gillnetting, disturbs the fish movements and scatters many fish beyond the range of the sonar. This can cause significant reduction in the estimates of passing fish. Commercial openings can attract intense fishing activity downstream of the sonar site and sometimes large numbers of fish that are expected are not observed due to the disturbance. These are continuing issues. As these problems occur managers are informed as to whether the daily estimates are thought to be conservative or not based on observations of the fishing activity and the general trajectory of the estimates before and after the fishing activity.

Similar to the local fishing pressure near the sonar site, is the problem of running a 24-hour sonar period as an assessment of the standard 3-3 hour sampling plan, i.e. if sonar is running continuously, then fishing is occurring in the ensonified zone, and we'd expect the counts obtained during those times to be affected. Because of this, the 24-hour period is not a true test of performance of the sampling system and has only been used anecdotally as a qualitative measure, i.e. the results from the 24-hour periods have not been used to change the sampling plan, or to adjust the daily estimates. The established 3-3 hour sampling schedule and the 24-hour sonar periods comparisons have historically shown relatively close agreement, but we expect the 24-hour counts to be lower, and that is most often the case. Between 1998 and 2007, 47 individual 24-hour periods were conducted. Of the estimates produced in these periods, 39 agreed within +/- 10% of the 3-3 hour estimates, and as expected, 60% of the 24-hour periods produced estimates that were lower than those produced from the standard 3-3 hour sampling (Appendix H.) This general agreement between the 24-hour estimates and the standard estimates through time indicate that continued testing of the performance of the sampling plan is unnecessary. Furthermore, the costs of the 24-hour periods are high, and for these reasons are being discontinued at the project.

In 2007 all project goals were met, with passage estimates given to fisheries managers daily during the season. Information generated at the Pilot Station sonar project was also disseminated weekly through multi-agency international teleconferences and data-sharing with stakeholders in areas from the lower Yukon River all the way to the spawning grounds in Canada.

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TABLES AND FIGURES

Table 1.–Initial split-beam sonar system settings.

Component	Setting	Stratum	Bank Left	Bank Right
Transducer	Beam size (h x w)		2.8º x 10.0º	6.0º x 10.0º
Echosounder	Transmit power (dB)		30	27
	Receiver gain (dB)		-15	-22
	Source Level (dB)		226.43	218.04
	Through-system gain (dB)		-162.60	-162.72
	Absorption coefficient (dB)		0.0	0.0
	Calculated threshold (dB)		-41	-40
	Pulse width (ms)		0.4	0.4
	Blanking range (m)		2.0	2.0
	Ping rate (pps)	S1		5.0
		S2		4.0
		S3	5.0	
		S4	4.0	
		S5	2.5	
	Range (m)	S1		50
		S2		150
		S3	50	
		S4	150	
		S5	250	
Chart recorder	Gray 1 (mV)		2.413	0.463
	Gray 2 (mV)		3.479	0.655
	Gray 3 (mV)		4.915	0.925
	Gray 4 (mV)		6.942	1.306

Table 2.–Technical specifications for the Dual-Frequency Identification Sonar.

Identification Mode	
Operating Frequency	1.2 MHz
Beam width (two-way)	0.5° H by 12 ° V
Number of beams	48
Range Settings	
Start range	0.83 m
Window length	20.01 m
Range bin size	39 mm
Pulse Length	46 µs
Frame rate	8 frames/s
Field of view	29°

Table 3.–Daily sampling schedule for sonar and test fish.

Time	Sonar: Right Bank	Sonar: Left Bank	Test Fishing
	Period 1		
5:30	S1	S3	
6:00	S2	S4	
6:30	S1	S5	
7:00	S2	S3	
7:30	S1	S4	
8:00	S2	S5	
8:30			
9:00			Period 1
9:30			
10:00			
10:30			
11:00			
11:30			
12:00			
12:30			
13:00	Period 2		
13:30	S1	S3	
14:00	S2	S4	
14:30	S1	S5	
15:00	S2	S3	
15:30	S1	S4	
16:00	S2	S5	
16:30			
17:00			Period 2
17:30			
18:00			
18:30			
19:00			
19:30			
20:00			
20:30			
21:00	Period 3		
21:30	S1	S3	
22:00	S2	S4	
22:30	S1	S5	
23:00	S2	S3	
23:30	S1	S4	
0:00	S2	S5	

Note: S1 = stratum 1, S2 = stratum 2, etc.

Table 4.–Specifications for drift gillnets used for test fishing, by season, 2007.

	Stretch Mesh Size		Mesh Diameter	Meshes Deep	Depth
Season	(in)	(mm)	(mm)	(MD)	(m)
Summer	2.75	70	44	131	8.0
(pre 7/19)	4.00	102	65	90	8.0
	5.25	133	85	69	8.0
	6.50	165	105	55	7.9
	7.50	191	121	48	8.0
	8.50	216	137	43	8.1
Fall	2.75	70	44	131	8.0
(post 7/18)	4.00	102	65	90	8.0
	5.00	127	81	72	8.0
	5.75	146	93	63	8.0
	6.50	165	105	55	7.9
	7.50	191	121	48	8.0

Table 5.–Fishing schedules for drift gillnets used during summer and fall season, 2007.

	Test Fish	Calendar Day			
Season	Period	Odd		Even	
		Mesh size (in)		Mesh size (in)	
Summer	1	2.75	5.25	8.5	4.0
(through 7/18)		7.5	6.5	7.5	6.5
	2	7.5	6.5	7.5	6.5
		8.5	4.0	2.7	5.25
Fall	1	4.0	5.75	2.75	7.5
(starting 7/19)		5.0	6.5	5.0	6.5
	2	5.0	6.5	5.0	6.5
		2.75	7.5	4.0	5.75

Table 6.–Number of fish caught and retained in the Pilot Station sonar test fishery, 2007.

Total Catch

	Chinook [a]	S Chum	F Chum	Sockeye	Coho	Pink	White Fish	Cisco	Burbot	Sheefish	Total all spp.
May	0	0	0	0	0	0	0	13	1	18	
June	354	1,405	0	0	0	0	29	37	22	164	
July	196	1,320	420	9	19	169	245	157	8	24	
August	1	0	1,175	3	973	45	149	144	14	6	
Total	551	2,725	1,595	12	992	214	423	351	45	212	7,120

Number of Fish Retained

	Chinook	S Chum	F Chum	Sockeye	Coho	Pink	White Fish	Cisco	Burbot	Sheefish	Total all spp.
May	0	0	0	0	0	0	2	0	1	15	
June	281	574	0	1	0	0	16	8	2	116	
July	166	526	150	5	16	0	225	75	1	19	
August	1	0	553	0	215	0	115	16	2	4	
Total	448	1,100	703	6	231	0	358	99	6	154	3,105

Percent of Total Catch Retained

	Chinook	S Chum	F Chum	Sockeye	Coho	Pink	White Fish	Cisco	Burbot	Sheefish	Total % retained
May	-	-	-	-	-	-	-	0.0%	100.0%	83.3%	
June	79.4%	40.9%	-	-	-	-	55.2%	21.6%	9.1%	70.7%	
July	84.7%	39.8%	35.7%	55.6%	84.2%	0.0%	91.8%	47.8%	12.5%	79.2%	
August	100.0%	-	0.0%	0.0%	22.1%	0.0%	77.2%	11.1%	14.3%	66.7%	
Total	81.3%	40.4%	44.1%	50.0%	23.3%	0.0%	84.6%	28.2%	13.3%	72.6%	43.8%

[a] Includes 179 Chinook salmon caught in the "Period 0" sampling test fish period. All other species captured during Period 0 were immediately released.

Table 7.–Cumulative passage estimates by zone and by species at Pilot Station sonar, with Standard Errors (S.E.) and 90% Confidence Intervals (CI), 2007.

		Left Bank		Total		90% CI	
Species	Right Bank	Nearshore	Offshore	Passage	S.E.	Lower	Upper
Large Chinook [a]	19,418	15,205	55,561	90,184	10,712	72,563	107,805
Small Chinook	9,164	14,731	11,474	35,369	5,955	25,574	45,164
Summer chum	654,132	299,445	773,308	1,726,885	53,697	1,638,554	1,815,216
Fall chum	137,222	56,422	490,367	684,011	28,842	636,566	731,456
Coho	104,885	11,431	56,973	173,289	12,608	152,549	194,029
Pink	6,774	58,109	6,816	71,699	12,009	51,944	91,454
Other	252,949	559,017	273,350	1,085,316	50,555	1,002,153	1,168,479
Total	1,184,544	1,014,360	1,667,849	3,866,753			

[a] Large Chinook salmon are >655 mm METF and small are ≤655 mm METF.

Table 8.–Reporting units of zones pooled for the 2007 season.

<table>
<tr><th rowspan="2">Date</th><th>Right Bank</th><th colspan="2">Left Bank</th><th rowspan="2">Reason for pooling [a]</th></tr>
<tr><th>(Zone 1)</th><th>Nearshore (Zone 2)</th><th>Offshore (Zone 3)</th></tr>
<tr><td>31 May</td><td rowspan="7">1</td><td rowspan="7">2</td><td rowspan="4">3</td><td></td></tr>
<tr><td>1 Jun</td><td></td></tr>
<tr><td>2 Jun</td><td></td></tr>
<tr><td>3 Jun</td><td>I.C.</td></tr>
<tr><td>4 Jun</td><td rowspan="2">4</td><td></td></tr>
<tr><td>5 Jun</td><td>I.C.</td></tr>
<tr><td>6 Jun</td><td rowspan="2">5</td><td></td></tr>
<tr><td>7 Jun</td><td>6</td><td>7</td><td>I.C.</td></tr>
<tr><td>8 Jun</td><td>9</td><td>10</td><td rowspan="3">11</td><td></td></tr>
<tr><td>9 Jun</td><td>12</td><td>13</td><td></td></tr>
<tr><td>10 Jun</td><td>14</td><td>15</td><td>I.C.</td></tr>
<tr><td>15 Jun</td><td rowspan="2">28</td><td rowspan="2">29</td><td rowspan="2">30</td><td>C.O.</td></tr>
<tr><td>16 Jun</td><td></td></tr>
<tr><td>19 Jun</td><td rowspan="3">37</td><td rowspan="3">38</td><td rowspan="3">39</td><td>C.O.</td></tr>
<tr><td>20 Jun</td><td>C.O.</td></tr>
<tr><td>21 Jun</td><td>C.O.</td></tr>
<tr><td>23 Jun</td><td rowspan="2">43</td><td rowspan="2">44</td><td rowspan="2">45</td><td></td></tr>
<tr><td>24 Jun</td><td>C.O.</td></tr>
<tr><td>25 Jun</td><td rowspan="2">46</td><td rowspan="2">47</td><td rowspan="2">48</td><td></td></tr>
<tr><td>26 Jun</td><td>C.O.</td></tr>
<tr><td>27 Jun</td><td rowspan="2">49</td><td rowspan="2">50</td><td rowspan="2">51</td><td></td></tr>
<tr><td>28 Jun</td><td>C.O.</td></tr>
<tr><td>2 Jul</td><td rowspan="2">61</td><td rowspan="2">62</td><td rowspan="2">63</td><td></td></tr>
<tr><td>3 Jul</td><td>C.O.</td></tr>
</table>

-continued-

Table 8.–Page 2 of 2.

Date	Right Bank (Zone 1)	Left Bank Nearshore (Zone 2)	Left Bank Offshore (Zone 3)	Reason for pooling [a]
7 Jul	73	74	75	
8 Jul				C.O.
15 Jul	94	95	96	I.C.
16 Jul	97	98		
22 Jul	114	115	116	I.C.
23 Jul	117	118		
15 Aug	185	186	187	C.O.
16 Aug				
19 Aug	194	195	196	
20 Aug				C.O.
22 Aug	200	201	202	
23 Aug				C.O.
24 Aug	203	204		
25 Aug	205	206	207	
26 Aug	208	209	210	
27 Aug				C.O.
29 Aug	214	215	216	C.O.
30 Aug				

[a] C.O. denotes that a commercial opening prevented test fishing, therefore pooling across days enables the variance estimation of species proportions. I.C. denotes that zones were pooled when there was insufficient catch in the test fishery for variance estimation.

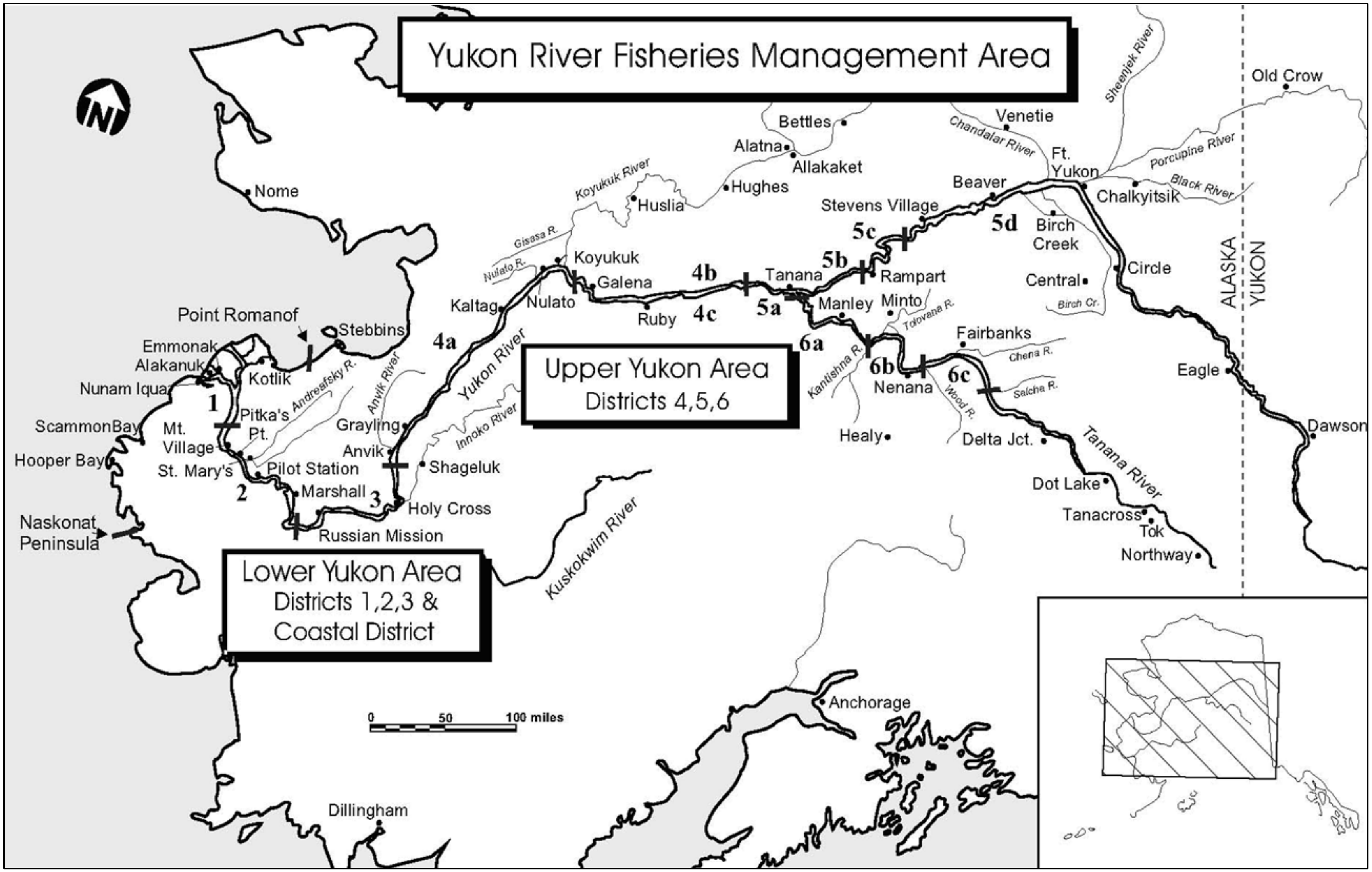


Figure 1.–Fishing districts and communities of the Yukon River watershed.

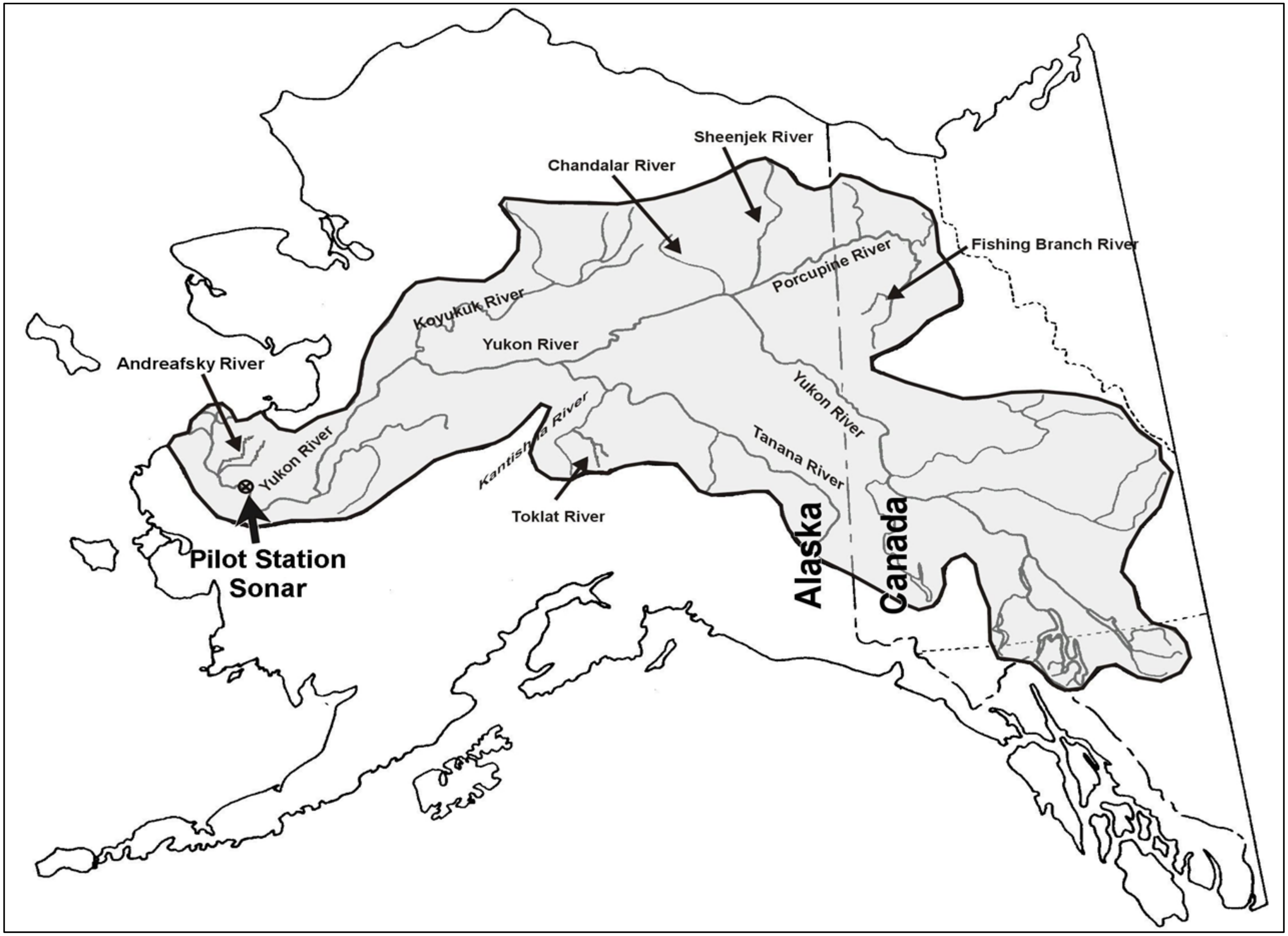


Figure 2.–Yukon River drainage showing salmon spawning tributaries.

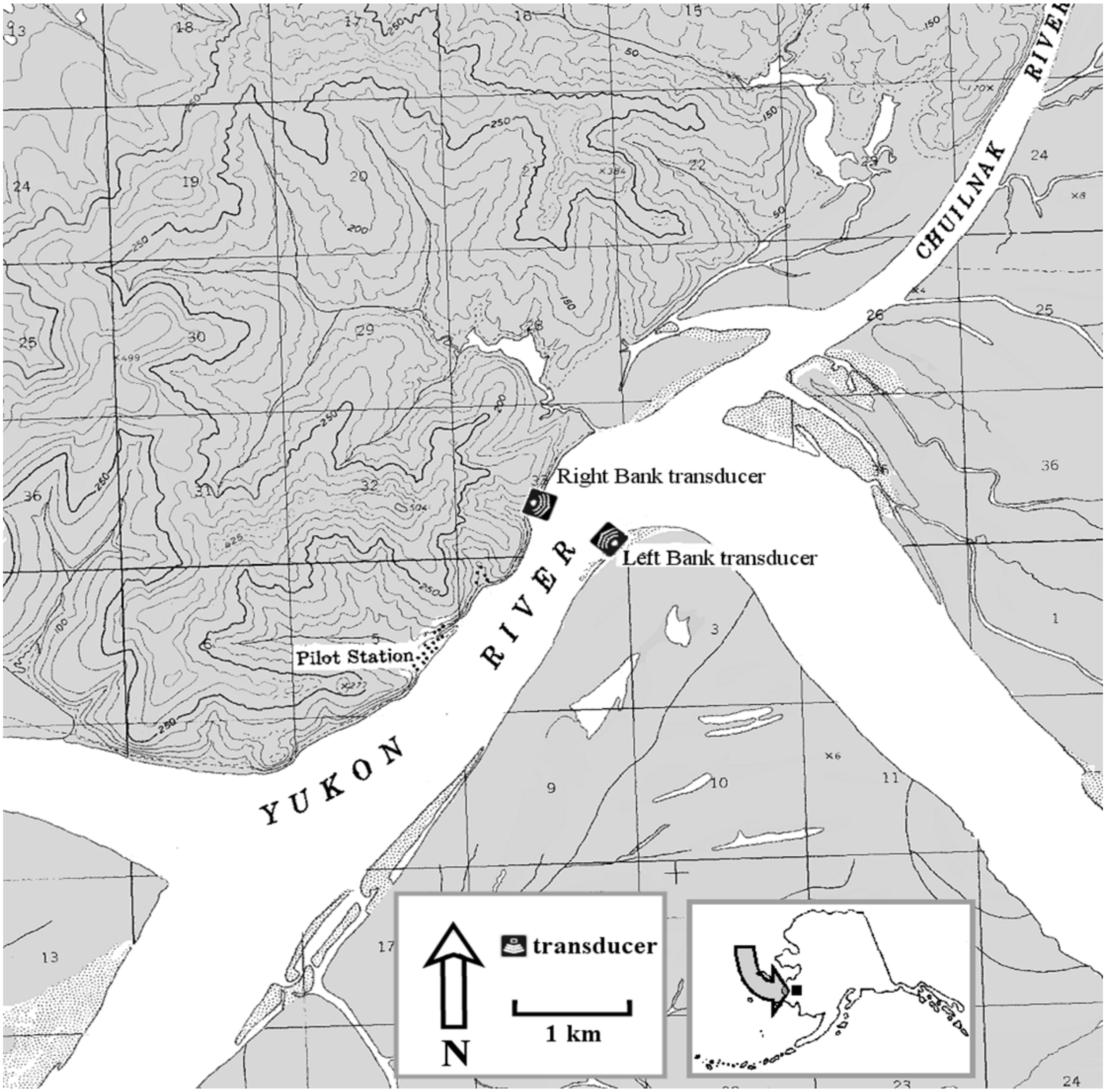
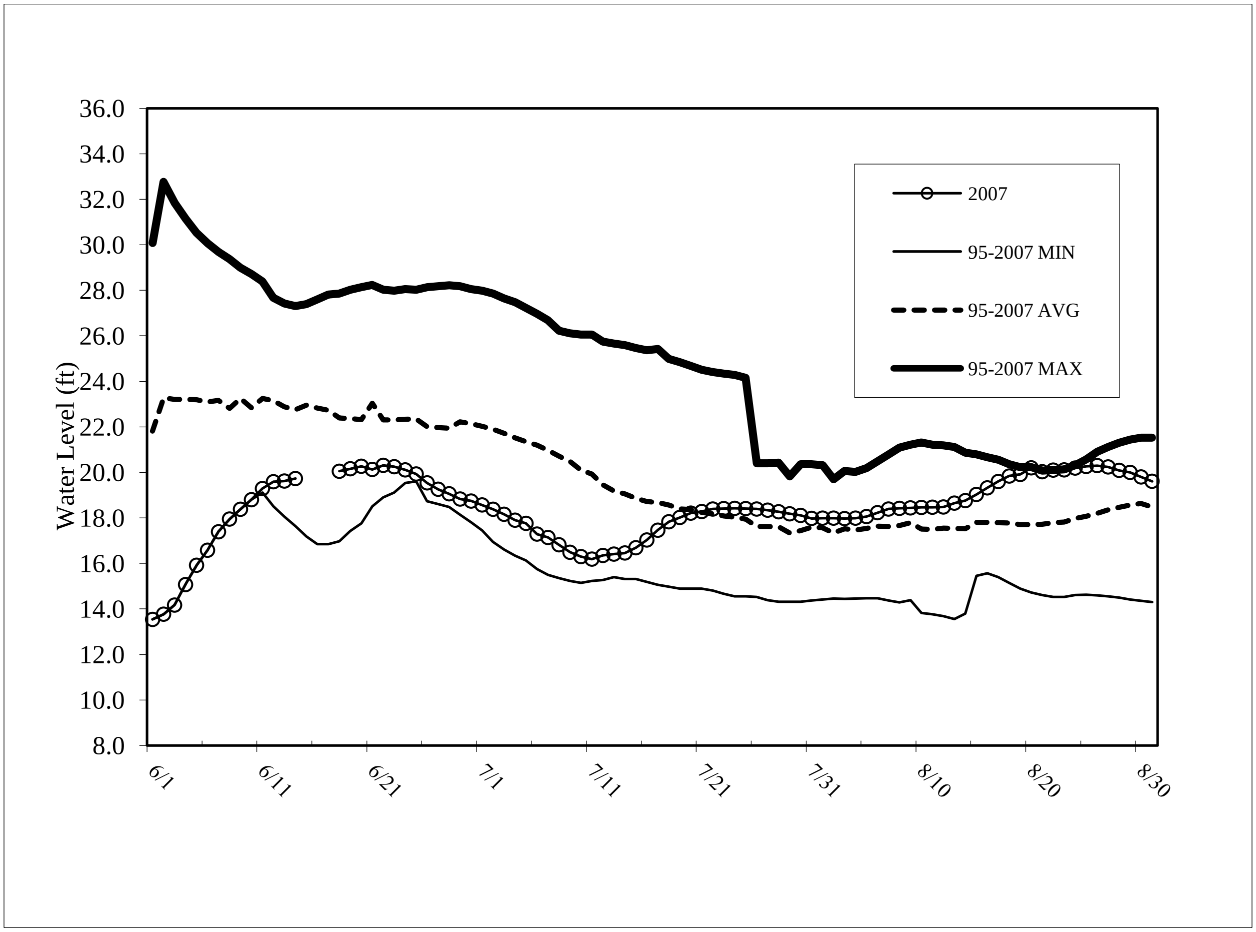


Figure 3.–Location of Pilot Station sonar project showing general transducer sites.



Source: United States Geological Service.

Figure 4.–Yukon River daily minimum, average and maximum water levels, at Pilot Station near the sonar project, 1995 to 2007.

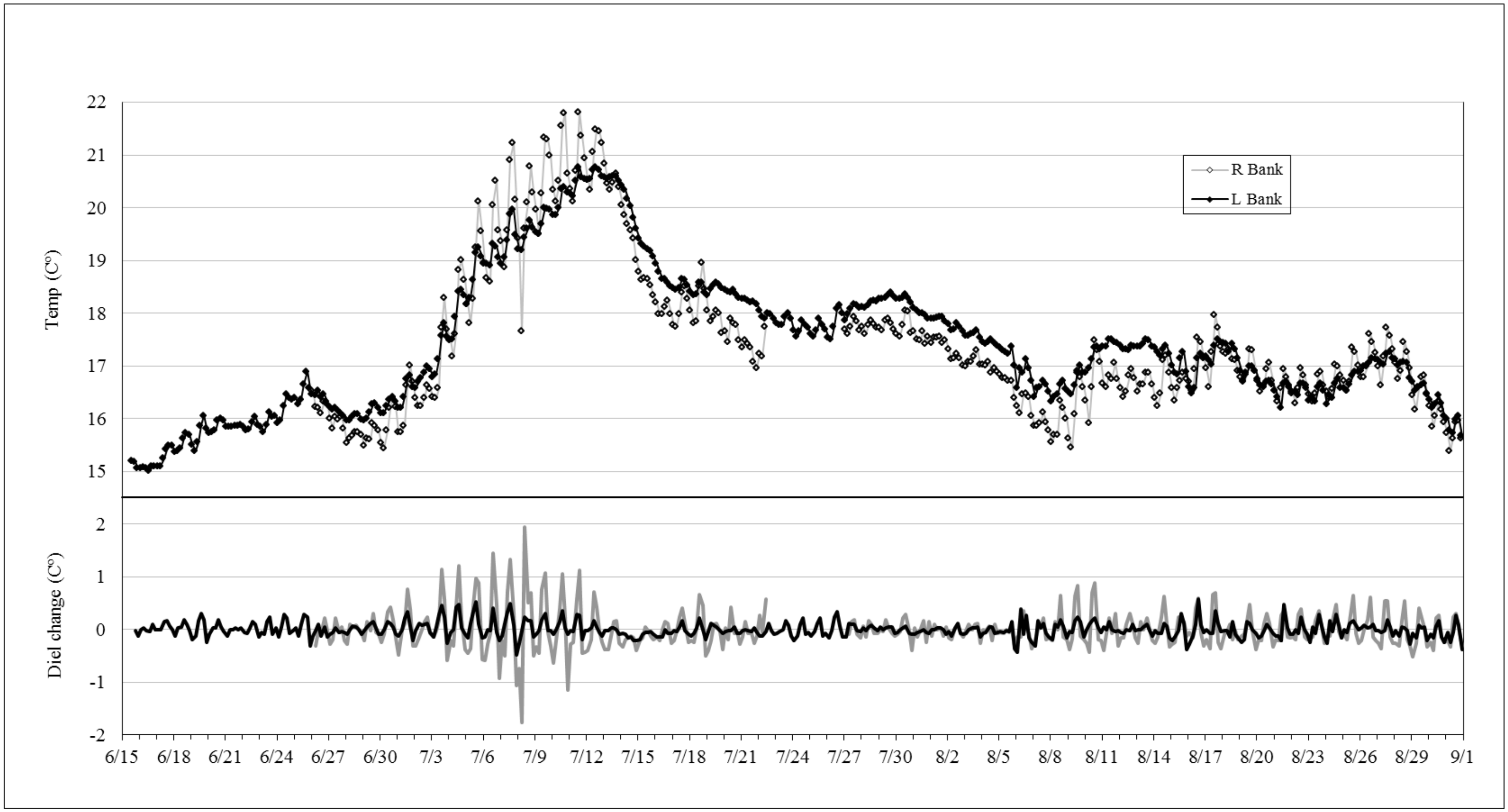


Figure 5.–Water temperatures recorded at Pilot Station sonar project with electronic data loggers, by bank with diel change, 2007.

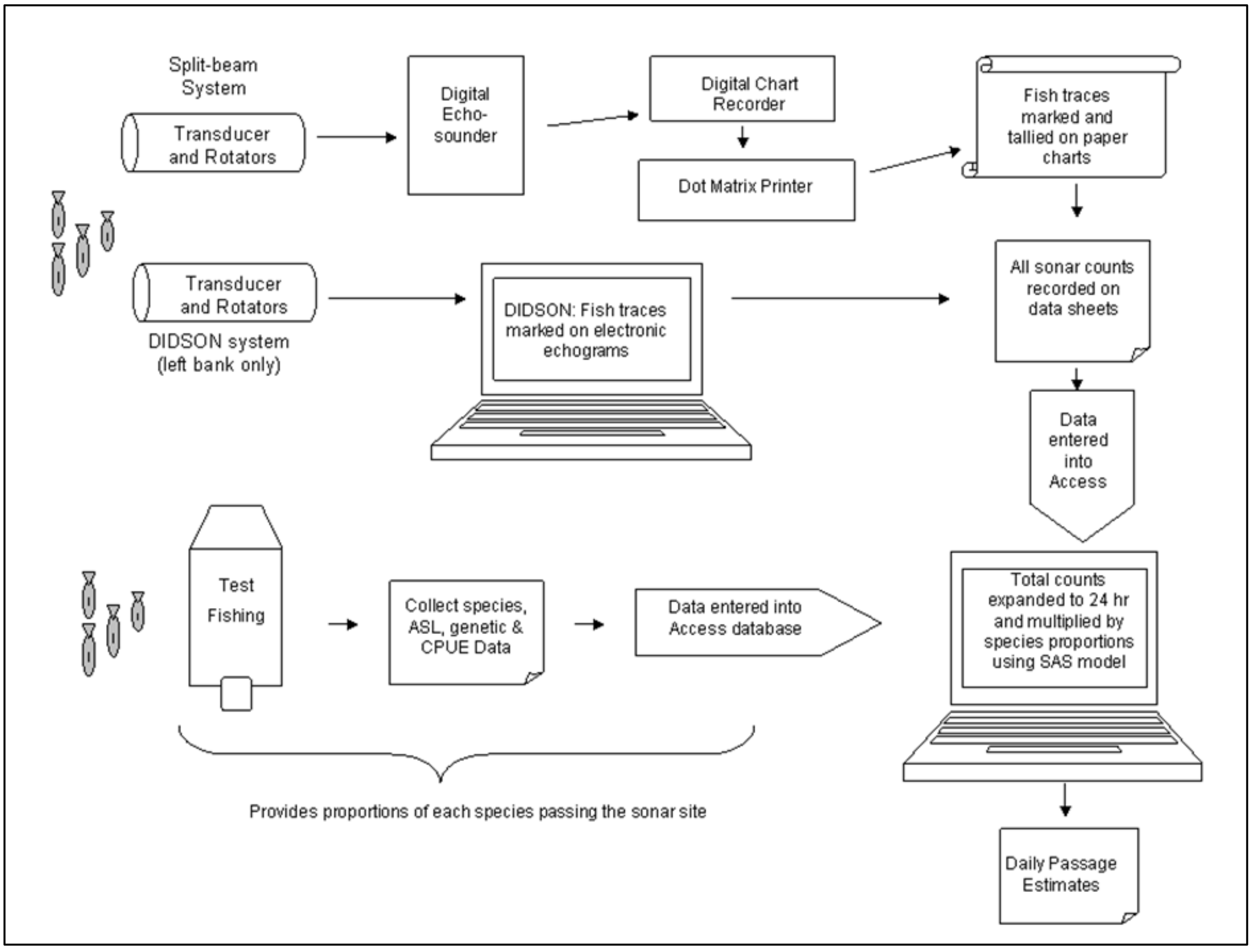


Figure 6.–Schematic of data collection and processing at Pilot Station sonar project.

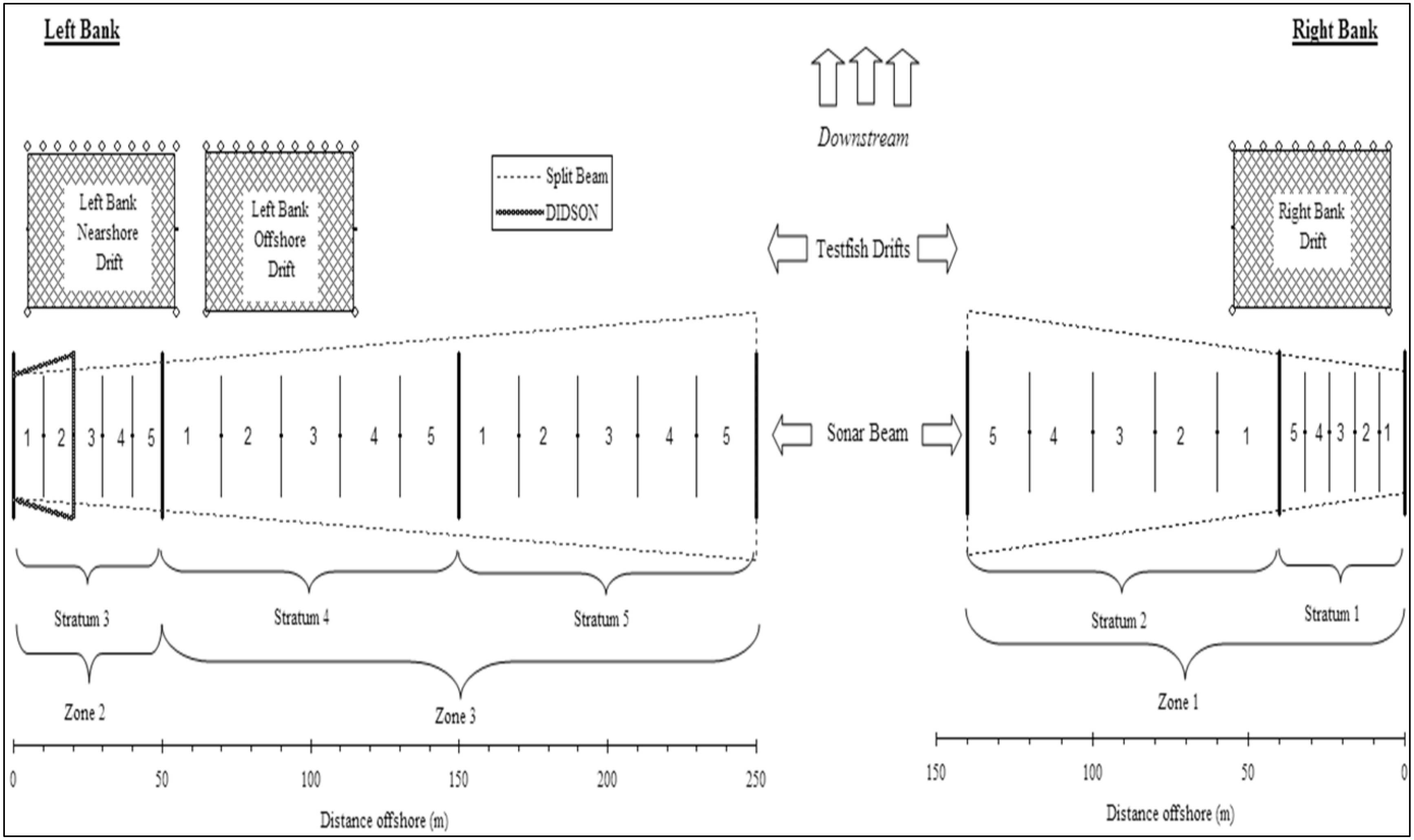


Figure 7.–Illustration of relationships between strata, sectors, zones, testfish drifts, and approximate sonar ranges (not to scale) at Pilot Station sonar project.

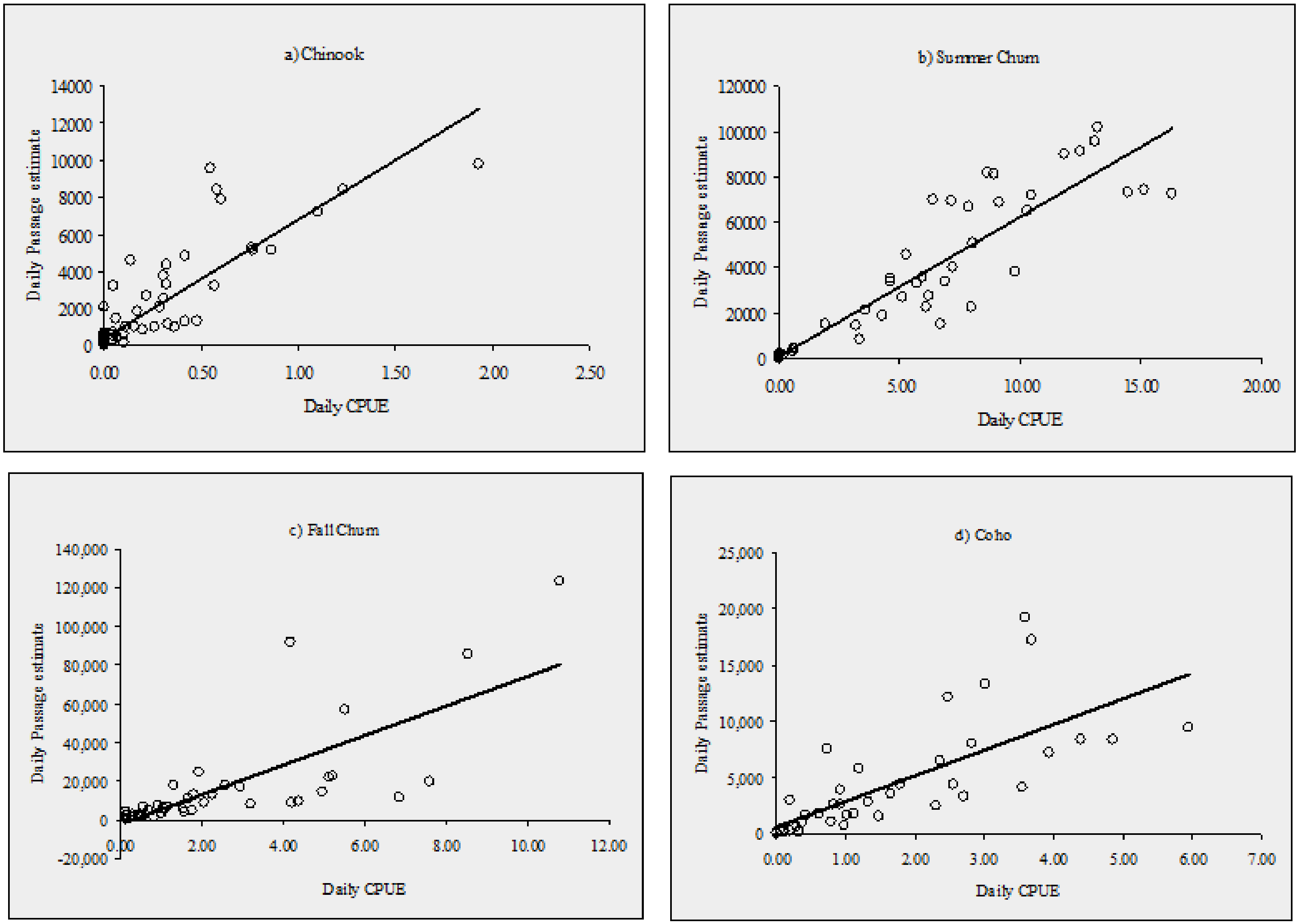


Figure 8.–Scatter plots of daily passage vs. CPUE for (a) Chinook, (b) summer chum, (c) fall chum, and (d) coho salmon, 2007.

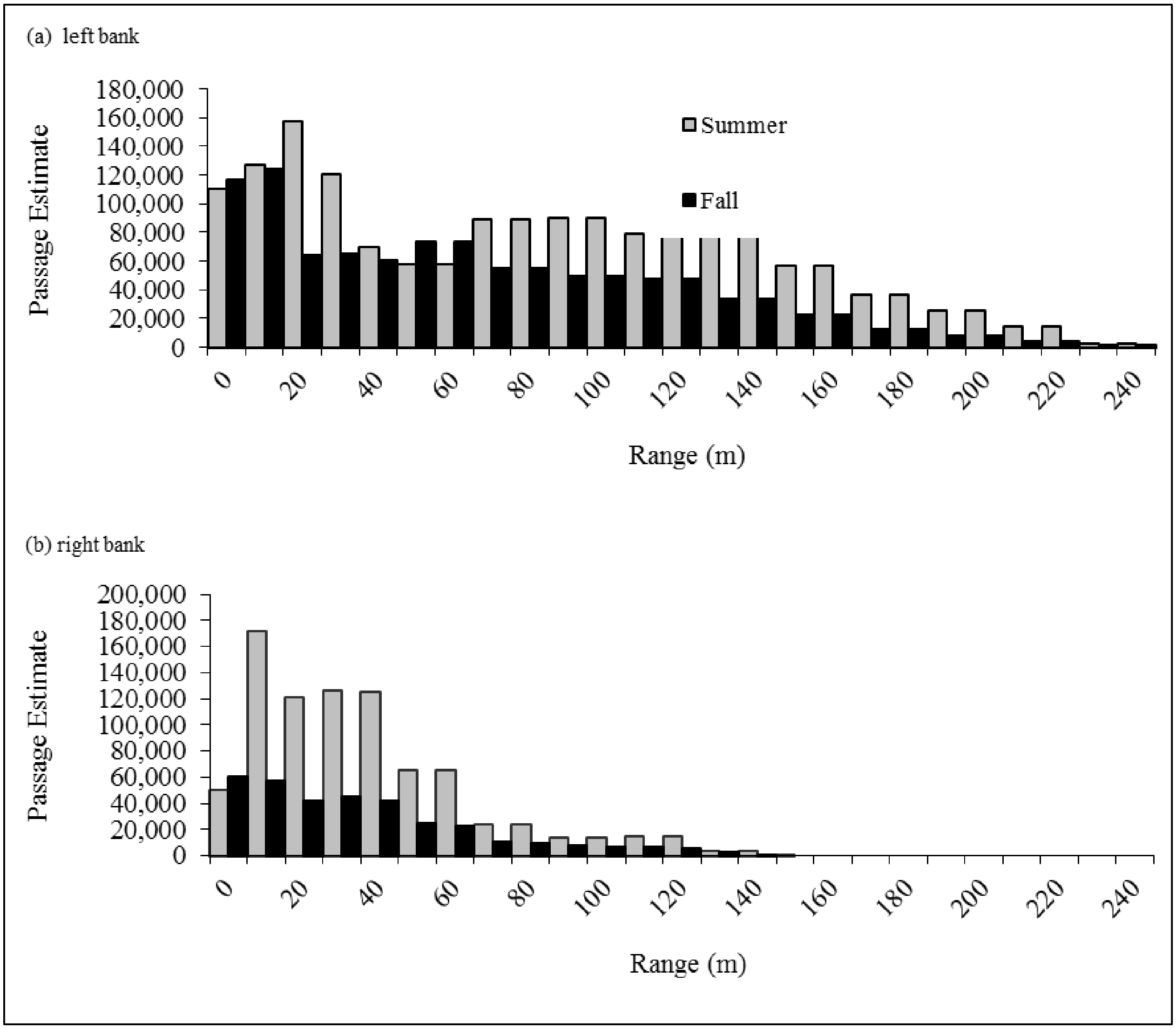


Figure 9.–Horizontal fish distribution (distance from transducer (m)) (a) left bank and (b) right bank by season, 2007.

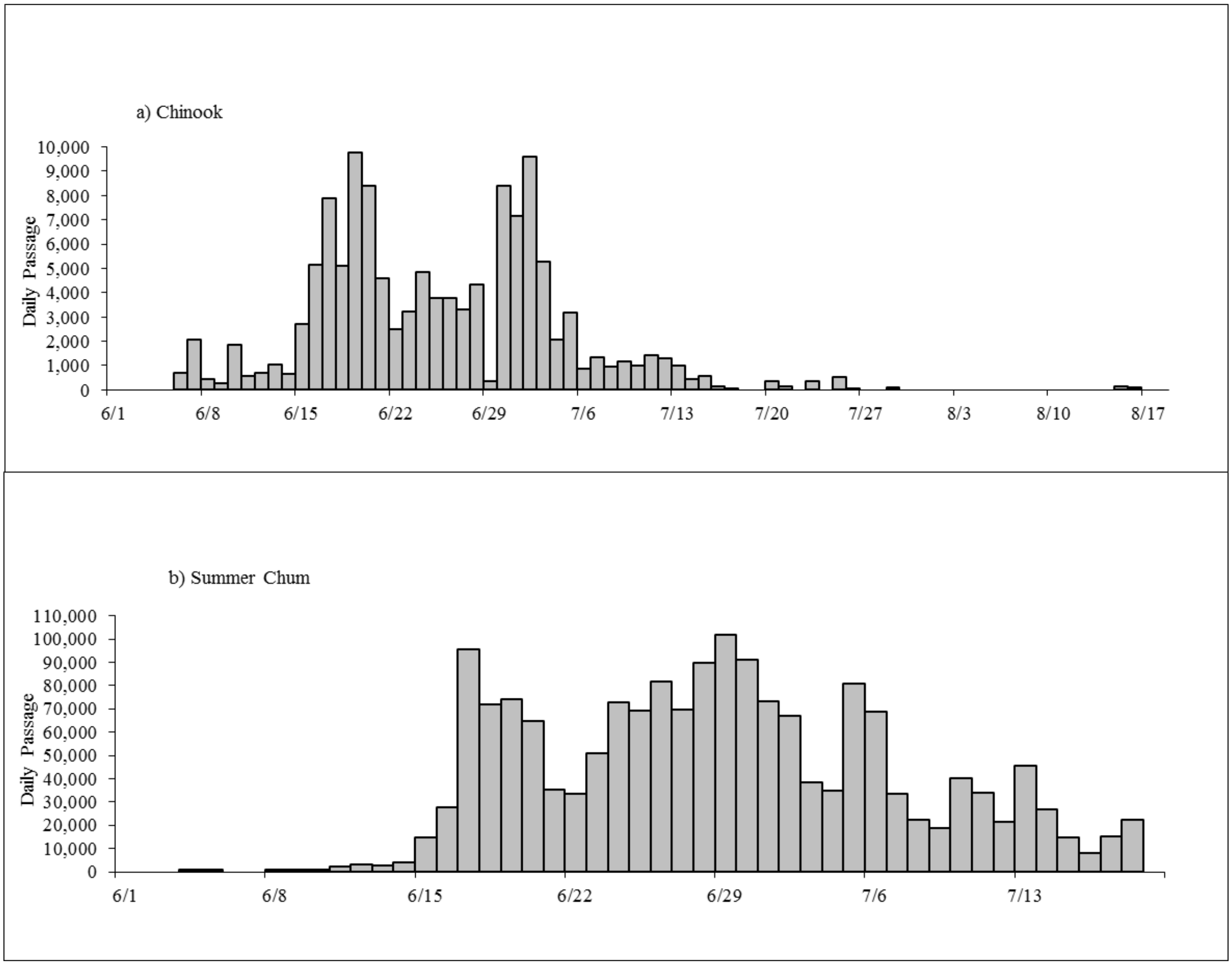


Figure 10.–Daily passage estimates of a) Chinook and b) summer chum salmon, 2007.

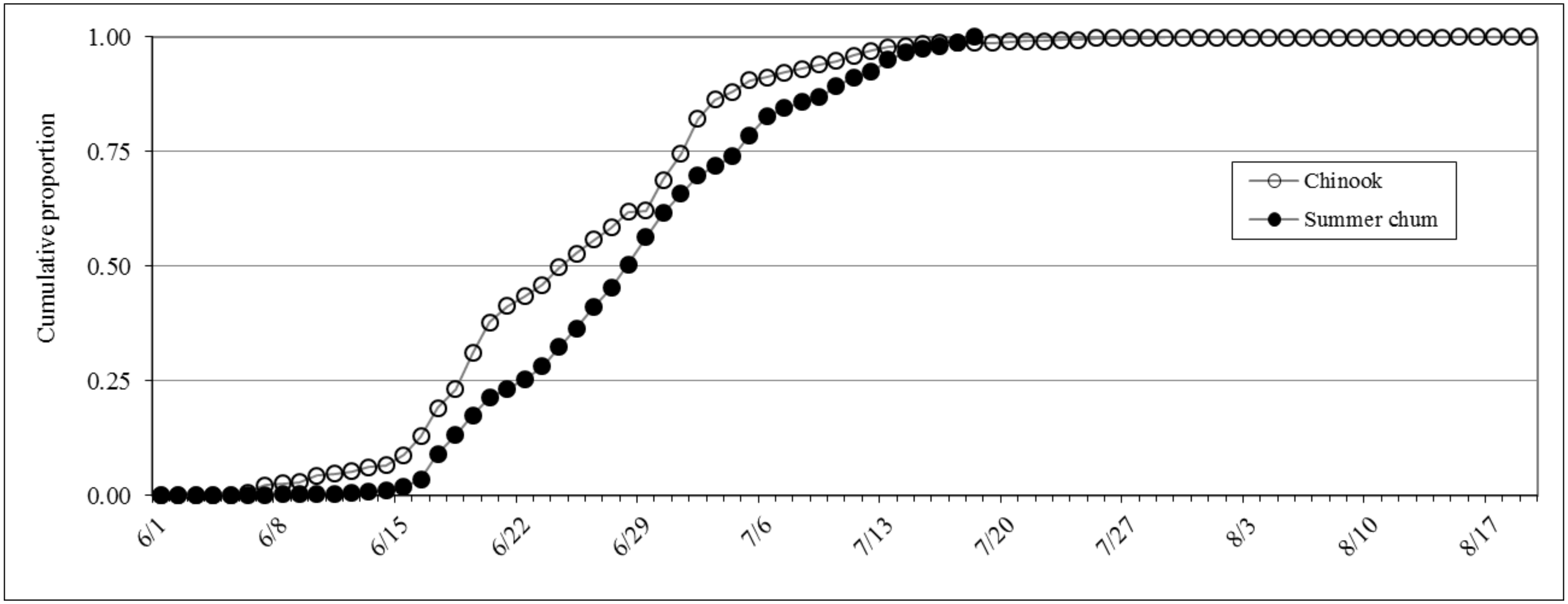


Figure 11.–Summer season daily cumulative passage timing, 2007.

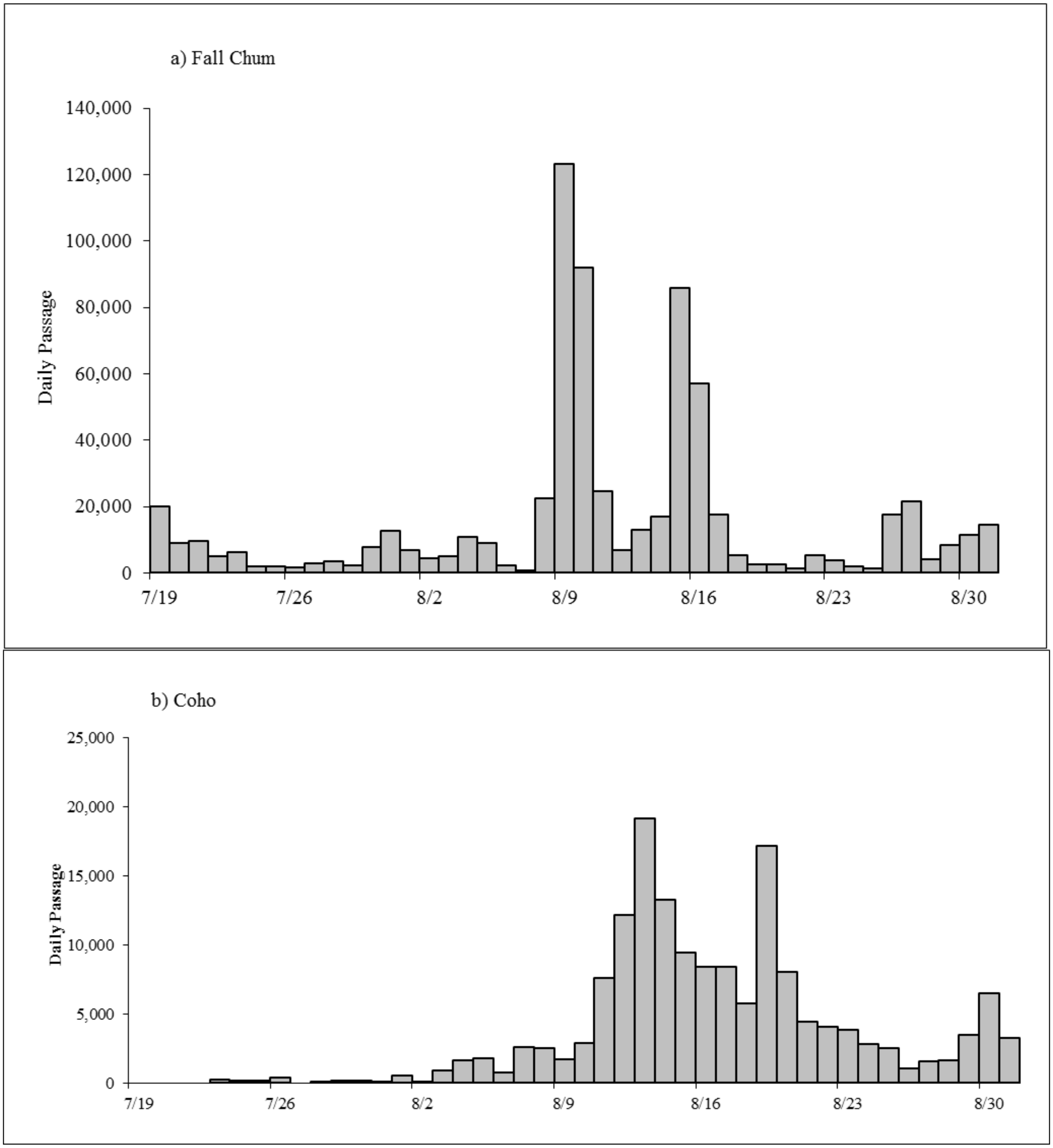


Figure 12.–Daily passage estimates of a) fall chum and b) coho salmon, 2007.

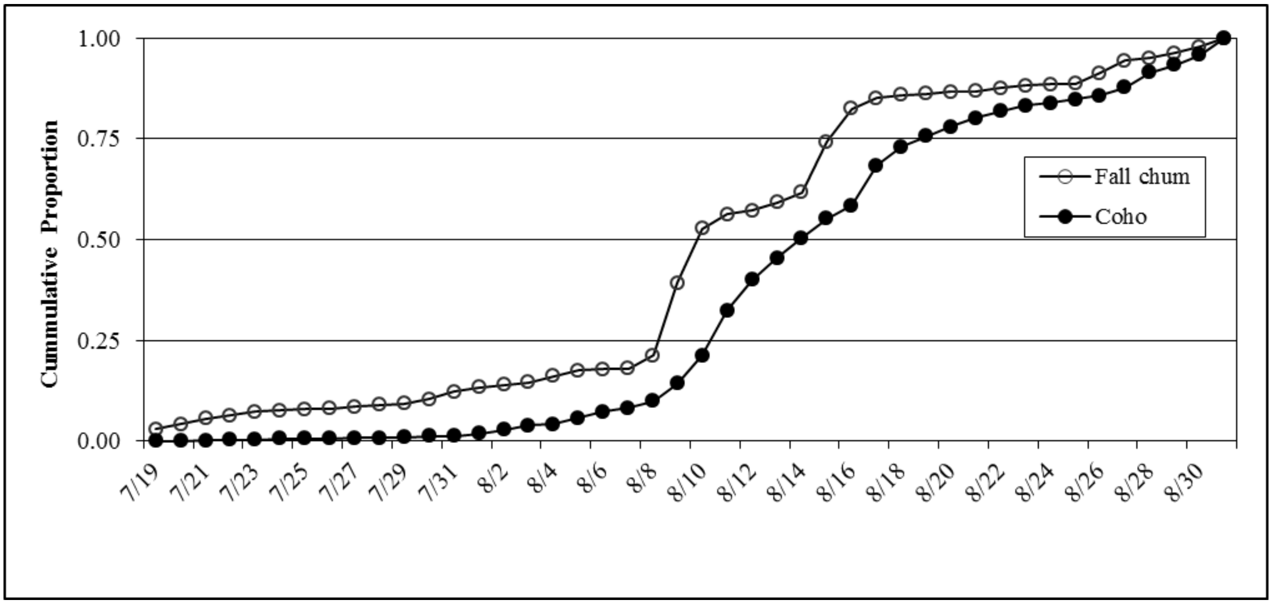


Figure 13.–Fall season daily cumulative passage timing, 2007.

APPENDIX A

Appendix A1.–Net selectivity parameters used in species apportionment at Pilot Station, 2007.

Species	Tau	Sigma	Theta	Lambda	Tangle
large Chinook [a]	1.9239	0.2361	0.6261	-0.5191	0
small Chinook [b]	1.9239	0.2361	0.6261	-0.5191	0
summer chum	1.9651	0.18	0.9414	-0.3884	0.03431
fall chum	1.8746	0.2255	1.2028	-1.2115	0.02757
coho	1.9821	0.3209	1.0248	-1.5954	0.09321
pink	1.8962	0.4828	2.0846	0.2148	0.1329
broad whitefish	1.841	0.2118	0.9502	-1.9363	0.1114
humpback whitefish	1.9004	0.2249	1.1071	-1.8815	0.1022
cisco	2.064	0.1929	1.7739	-1.2745	0.1728
other	2.2249	0.3304	0.9199	-2.221	0.08338

[a] Chinook salmon >655 mm.

[b] Chinook salmon ≤655mm.

APPENDIX B

Appendix B1.–Right bank CPUE by day, 2007.

Date	Lg. Mesh Fathom hrs	Chinook Catch	Chinook CPUE	Sm. Mesh Fathom hrs	Summer chum Catch	Summer chum CPUE	Fall chum Catch	Fall chum CPUE	Coho Catch	Coho CPUE
29 May	3.58	0	0.00	0	0	0.00	0	0.00	0	0.00
30 May	9.45	0	0.00	9.92	0	0.00	0	0.00	0	0.00
31 May	9.98	0	0.00	9.9	0	0.00	0	0.00	0	0.00
1 Jun	10.97	0	0.00	10.62	0	0.00	0	0.00	0	0.00
2 Jun	9.31	0	0.00	10.63	0	0.00	0	0.00	0	0.00
3 Jun	10.05	0	0.00	9.61	0	0.00	0	0.00	0	0.00
4 Jun	9.6	0	0.00	9.06	0	0.00	0	0.00	0	0.00
5 Jun	10.04	0	0.00	9.97	0	0.00	0	0.00	0	0.00
6 Jun	9.77	0	0.00	9.62	0	0.00	0	0.00	0	0.00
7 Jun	9.17	0	0.00	8.82	0	0.00	0	0.00	0	0.00
8 Jun	11.58	0	0.00	6.85	0	0.00	0	0.00	0	0.00
9 Jun	11.51	0	0.00	5.67	0	0.00	0	0.00	0	0.00
10 Jun	8.38	1	0.12	8.72	1	0.11	0	0.00	0	0.00
11 Jun	7.85	0	0.00	9.89	0	0.00	0	0.00	0	0.00
12 Jun	9.25	0	0.00	7.34	2	0.27	0	0.00	0	0.00
13 Jun	9.21	2	0.22	9.19	4	0.44	0	0.00	0	0.00
14 Jun	9.78	1	0.10	8.74	1	0.11	0	0.00	0	0.00
15 Jun	6.6	0	0.00	6.18	3	0.49	0	0.00	0	0.00
16 Jun	8.95	1	0.11	7.34	16	2.18	0	0.00	0	0.00
17 Jun	7.21	1	0.14	5.82	49	8.42	0	0.00	0	0.00
18 Jun	6.7	3	0.45	5.92	31	5.24	0	0.00	0	0.00
19 Jun	3.49	3	0.86	2.29	26	11.36	0	0.00	0	0.00
20 Jun	5.33	2	0.38	2.44	13	5.33	0	0.00	0	0.00
21 Jun	4.52	0	0.00	4.5	8	1.78	0	0.00	0	0.00
22 Jun	9.39	2	0.21	6.78	17	2.51	0	0.00	0	0.00
23 Jun	8.1	0	0.00	5.74	29	5.05	0	0.00	0	0.00
24 Jun	5.79	0	0.00	1.97	17	8.65	0	0.00	0	0.00
25 Jun	9.26	1	0.11	5.22	24	4.60	0	0.00	0	0.00
26 Jun	5.74	0	0.00	2.48	13	5.24	0	0.00	0	0.00
27 Jun	8.58	1	0.12	4.61	20	4.34	0	0.00	0	0.00
28 Jun	6.43	0	0.00	4.32	20	4.63	0	0.00	0	0.00
29 Jun	7.73	0	0.00	5.74	37	6.45	0	0.00	0	0.00
30 Jun	8.41	4	0.48	3.48	31	8.91	0	0.00	0	0.00
1 Jul	9.09	5	0.55	4.56	20	4.38	0	0.00	0	0.00
2 Jul	9.2	1	0.11	6	28	4.67	0	0.00	0	0.00
3 Jul	5.96	3	0.50	3.97	25	6.30	0	0.00	0	0.00
4 Jul	9.5	2	0.21	5.94	14	2.36	0	0.00	0	0.00
5 Jul	8.97	3	0.33	4.75	26	5.48	0	0.00	0	0.00
6 Jul	9.2	1	0.11	7.32	45	6.15	0	0.00	0	0.00
7 Jul	9.32	4	0.43	8.6	40	4.65	0	0.00	0	0.00
8 Jul	6.09	1	0.16	4.5	22	4.89	0	0.00	0	0.00
9 Jul	9.88	3	0.30	6.45	24	3.72	0	0.00	0	0.00
10 Jul	10.74	2	0.19	5.35	28	5.23	0	0.00	0	0.00
11 Jul	7.5	0	0.00	5.06	28	5.53	0	0.00	0	0.00
12 Jul	8.09	3	0.37	5.59	17	3.04	0	0.00	0	0.00
13 Jul	8.99	1	0.11	7.43	31	4.17	0	0.00	0	0.00
14 Jul	9.95	0	0.00	6.9	27	3.91	0	0.00	0	0.00
15 Jul	7.32	0	0.00	7.16	21	2.93	0	0.00	0	0.00
16 Jul	10.28	1	0.1	7.05	22	3.12	0	0.00	0	0.00

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Appendix B1.–Page 2 of 2.

Date	Lg. Mesh Fathom hrs	Chinook		Sm. Mesh Fathom hrs	Summer chum		Fall chum		Coho	
		Catch	CPUE		Catch	CPUE	Catch	CPUE	Catch	CPUE
17 Jul	7.73	0	0.00	9.37	59	6.30	0	0.00	0	0.00
18 Jul	7.53	0	0.00	6.12	43	7.03	0	0.00	0	0.00
19 Jul	4.27	0	0.00	3.18	0	0.00	21	6.60	0	0.00
20 Jul	2.9	0	0.00	7.55	0	0.00	29	3.84	0	0.00
21 Jul	3.34	0	0.00	5.31	0	0.00	20	3.76	1	0.19
22 Jul	3.79	0	0.00	8.39	0	0.00	13	1.55	0	0.00
23 Jul	2	0	0.00	8.58	0	0.00	8	0.93	1	0.12
24 Jul	3.82	0	0.00	9.26	0	0.00	4	0.43	0	0.00
25 Jul	2.76	0	0.00	9.14	0	0.00	1	0.11	0	0.00
26 Jul	2.88	0	0.00	9.85	0	0.00	7	0.71	0	0.00
27 Jul	3.52	0	0.00	10.01	0	0.00	3	0.30	0	0.00
28 Jul	3.8	0	0.00	9.34	0	0.00	9	0.96	3	0.32
29 Jul	2.85	0	0.00	9.6	0	0.00	5	0.52	1	0.10
30 Jul	3.17	0	0.00	8.52	0	0.00	6	0.70	2	0.23
31 Jul	2.42	0	0.00	8.9	0	0.00	12	1.35	0	0.00
1 Aug	3.26	0	0.00	9.27	0	0.00	7	0.76	3	0.32
2 Aug	6.2	0	0.00	5.5	0	0.00	0	0.00	2	0.36
3 Aug	3	0	0.00	10.55	0	0.00	5	0.47	6	0.57
4 Aug	2.72	0	0.00	9.27	0	0.00	11	1.19	9	0.97
5 Aug	3.32	0	0.00	7.63	0	0.00	11	1.44	7	0.92
6 Aug	3.16	0	0.00	8.57	0	0.00	2	0.23	7	0.82
7 Aug	2.85	0	0.00	8.39	0	0.00	1	0.12	9	1.07
8 Aug	2.82	0	0.00	6.97	0	0.00	25	3.59	1	0.14
9 Aug	2.74	0	0.00	6.3	0	0.00	34	5.40	3	0.48
10 Aug	2.67	0	0.00	4.86	0	0.00	12	2.47	10	2.06
11 Aug	2.96	0	0.00	7.43	0	0.00	7	0.94	24	3.23
12 Aug	2.5	0	0.00	6.15	0	0.00	1	0.16	14	2.28
13 Aug	3.27	0	0.00	6.25	0	0.00	8	1.28	35	5.60
14 Aug	2.83	0	0.00	7.25	0	0.00	12	1.66	31	4.28
15 Aug	1.68	0	0.00	3.88	0	0.00	20	5.16	17	4.39
16 Aug	2.81	0	0.00	4.66	0	0.00	19	4.08	5	1.07
17 Aug	2.58	0	0.00	7.86	0	0.00	4	0.51	27	3.43
18 Aug	2.64	0	0.00	5.67	0	0.00	4	0.71	16	2.82
19 Aug	2.39	0	0.00	7.21	0	0.00	2	0.28	18	2.50
20 Aug	2.6	0	0.00	5.92	0	0.00	2	0.34	21	3.55
21 Aug	2.82	0	0.00	8.05	0	0.00	0	0.00	7	0.87
22 Aug	2.8	0	0.00	6.82	0	0.00	5	0.73	9	1.32
23 Aug	2.58	0	0.00	4.33	0	0.00	0	0.00	9	2.08
24 Aug	3.08	0	0.00	7.73	0	0.00	1	0.13	6	0.78
25 Aug	2.79	0	0.00	8.11	0	0.00	2	0.25	11	1.36
26 Aug	2.68	0	0.00	7.33	0	0.00	12	1.64	7	0.95
27 Aug	2.12	0	0.00	3.63	0	0.00	6	1.65	6	1.65
28 Aug	2.9	0	0.00	6.91	0	0.00	8	1.16	16	2.31
29 Aug	2.8	0	0.00	4.57	0	0.00	10	2.19	12	2.63
30 Aug	1.9	0	0.00	3.92	0	0.00	19	4.85	7	1.79
31 Aug	2.55	0	0.00	5.43	0	0.00	15	2.76	20	3.68
Total	556.6	52.0	6.8	645.6	882.0	170.0	403.0	67.9	383.0	61.2

Appendix B2.–Left bank CPUE by day, 2007.

Date	Lg. Mesh Fathom hrs	Chinook Catch	Chinook CPUE	Sm. Mesh Fathom hrs	Summer chum Catch	Summer chum CPUE	Fall chum Catch	Fall chum CPUE	Coho Catch	Coho CPUE
29 May	9.84	0	0.00	0.00	0	0.00	0	0.00	0	0.00
30 May	20.91	0	0.00	20.40	0	0.00	0	0.00	0	0.00
31 May	20.85	0	0.00	20.58	0	0.00	0	0.00	0	0.00
1 Jun	21.43	0	0.00	21.57	0	0.00	0	0.00	0	0.00
2 Jun	20.96	0	0.00	22.87	0	0.00	0	0.00	0	0.00
3 Jun	20.62	0	0.00	21.31	0	0.00	0	0.00	0	0.00
4 Jun	19.10	0	0.00	21.52	0	0.00	0	0.00	0	0.00
5 Jun	20.89	0	0.00	19.69	0	0.00	0	0.00	0	0.00
6 Jun	23.65	0	0.00	22.72	0	0.00	0	0.00	0	0.00
7 Jun	23.56	0	0.00	22.19	0	0.00	0	0.00	0	0.00
8 Jun	28.21	2	0.07	14.60	0	0.00	0	0.00	0	0.00
9 Jun	25.85	1	0.04	14.95	0	0.00	0	0.00	0	0.00
10 Jun	20.56	1	0.05	22.32	1	0.04	0	0.00	0	0.00
11 Jun	22.26	1	0.04	20.13	1	0.05	0	0.00	0	0.00
12 Jun	21.24	1	0.05	23.37	7	0.30	0	0.00	0	0.00
13 Jun	22.50	1	0.04	20.84	4	0.19	0	0.00	0	0.00
14 Jun	21.79	0	0.00	23.63	11	0.47	0	0.00	0	0.00
15 Jun	13.64	3	0.22	12.99	19	1.46	0	0.00	0	0.00
16 Jun	18.65	14	0.75	16.42	66	4.02	0	0.00	0	0.00
17 Jun	15.26	7	0.46	12.72	60	4.72	0	0.00	0	0.00
18 Jun	18.64	6	0.32	16.68	87	5.21	0	0.00	0	0.00
19 Jun	10.24	11	1.07	6.63	25	3.77	0	0.00	0	0.00
20 Jun	9.92	2	0.20	7.82	39	4.99	0	0.00	0	0.00
21 Jun	13.80	2	0.14	7.70	32	4.16	0	0.00	0	0.00
22 Jun	20.11	2	0.10	14.78	31	2.10	0	0.00	0	0.00
23 Jun	19.22	1	0.05	14.11	42	2.98	0	0.00	0	0.00
24 Jun	11.98	5	0.42	3.92	30	7.66	0	0.00	0	0.00
25 Jun	20.40	4	0.20	13.55	35	2.58	0	0.00	0	0.00
26 Jun	12.70	4	0.31	6.79	23	3.39	0	0.00	0	0.00
27 Jun	20.36	4	0.20	11.09	23	2.07	0	0.00	0	0.00
28 Jun	12.60	4	0.32	6.77	49	7.24	0	0.00	0	0.00
29 Jun	19.89	1	0.05	12.25	83	6.78	0	0.00	0	0.00
30 Jun	17.41	13	0.75	10.30	37	3.59	0	0.00	0	0.00
1 Jul	18.25	10	0.55	6.81	69	10.13	0	0.00	0	0.00
2 Jul	18.20	8	0.44	14.65	47	3.21	0	0.00	0	0.00
3 Jul	11.72	3	0.26	8.05	28	3.48	0	0.00	0	0.00
4 Jul	24.08	2	0.08	14.49	33	2.28	0	0.00	0	0.00
5 Jul	20.81	5	0.24	12.49	43	3.44	0	0.00	0	0.00
6 Jul	21.41	2	0.09	17.66	53	3.00	0	0.00	0	0.00
7 Jul	20.77	1	0.05	18.15	20	1.10	0	0.00	0	0.00
8 Jul	13.35	0	0.00	11.38	14	1.23	0	0.00	0	0.00
9 Jul	29.06	1	0.03	13.90	8	0.58	0	0.00	0	0.00
10 Jul	22.94	4	0.17	15.18	30	1.98	0	0.00	0	0.00
11 Jul	18.07	1	0.06	16.21	22	1.36	0	0.00	0	0.00
12 Jul	19.00	1	0.05	19.09	10	0.52	0	0.00	0	0.00
13 Jul	20.69	0	0.00	17.83	20	1.12	0	0.00	0	0.00
14 Jul	20.26	0	0.00	19.86	24	1.21	0	0.00	0	0.00
15 Jul	19.64	0	0.00	17.17	5	0.29	0	0.00	0	0.00
16 Jul	18.46	0	0.00	19.64	5	0.25	0	0.00	0	0.00
17 Jul	18.47	0	0.00	18.96	8	0.42	0	0.00	0	0.00
18 Jul	19.18	0	0.00	21.34	21	0.98	0	0.00	0	0.00

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Appendix B2.–Page 2 of 2.

Date	Lg. Mesh Fathom hrs	Chinook Catch	Chinook CPUE	Sm. Mesh Fathom hrs	Summer chum Catch	Summer chum CPUE	Fall chum Catch	Fall chum CPUE	Coho Catch	Coho CPUE
19 Jul	11.71	0	0.00	11.13	0	0.00	11	0.99	0	0.00
20 Jul	6.78	0	0.00	18.43	0	0.00	7	0.38	0	0.00
21 Jul	7.66	0	0.00	15.00	0	0.00	9	0.60	0	0.00
22 Jul	7.38	0	0.00	18.78	0	0.00	4	0.21	0	0.00
23 Jul	6.48	0	0.00	18.90	0	0.00	2	0.11	0	0.00
24 Jul	7.66	0	0.00	20.49	0	0.00	0	0.00	1	0.05
25 Jul	7.06	0	0.00	20.24	0	0.00	1	0.05	0	0.00
26 Jul	7.42	0	0.00	21.27	0	0.00	2	0.09	0	0.00
27 Jul	7.33	0	0.00	20.08	0	0.00	4	0.20	0	0.00
28 Jul	8.10	0	0.00	19.50	0	0.00	1	0.05	0	0.00
29 Jul	6.51	0	0.00	20.74	0	0.00	0	0.00	0	0.00
30 Jul	6.21	0	0.00	19.17	0	0.00	4	0.21	1	0.05
31 Jul	6.58	0	0.00	20.04	0	0.00	9	0.45	0	0.00
1 Aug	6.25	0	0.00	20.40	0	0.00	8	0.39	1	0.05
2 Aug	13.46	0	0.00	14.05	0	0.00	2	0.14	1	0.07
3 Aug	6.97	0	0.00	21.60	0	0.00	5	0.23	1	0.05
4 Aug	6.72	0	0.00	19.71	0	0.00	9	0.46	0	0.00
5 Aug	6.78	0	0.00	18.98	0	0.00	12	0.63	0	0.00
6 Aug	6.86	0	0.00	19.74	0	0.00	1	0.05	0	0.00
7 Aug	8.18	0	0.00	21.22	0	0.00	0	0.00	1	0.05
8 Aug	5.71	0	0.00	17.05	0	0.00	28	1.64	1	0.06
9 Aug	4.96	0	0.00	12.45	0	0.00	67	5.38	3	0.24
10 Aug	4.18	0	0.00	12.31	0	0.00	21	1.71	5	0.41
11 Aug	5.86	0	0.00	14.22	0	0.00	14	0.98	5	0.35
12 Aug	5.64	0	0.00	17.58	0	0.00	7	0.40	13	0.74
13 Aug	6.79	0	0.00	14.49	0	0.00	14	0.97	5	0.34
14 Aug	6.11	0	0.00	15.90	0	0.00	20	1.26	9	0.57
15 Aug	6.17	0	0.00	11.52	0	0.00	39	3.39	0	0.00
16 Aug	5.75	0	0.00	16.93	0	0.00	24	1.42	2	0.12
17 Aug	6.93	0	0.00	19.21	0	0.00	15	0.78	5	0.26
18 Aug	5.47	0	0.00	18.82	0	0.00	7	0.37	0	0.00
19 Aug	7.06	0	0.00	18.16	0	0.00	3	0.17	1	0.06
20 Aug	5.81	0	0.00	11.68	0	0.00	3	0.26	0	0.00
21 Aug	6.58	0	0.00	19.62	0	0.00	5	0.25	1	0.05
22 Aug	5.38	0	0.00	19.08	0	0.00	15	0.79	0	0.00
23 Aug	5.58	0	0.00	8.85	0	0.00	1	0.11	2	0.23
24 Aug	6.46	0	0.00	18.40	0	0.00	0	0.00	0	0.00
25 Aug	5.85	0	0.00	17.58	0	0.00	1	0.06	2	0.11
26 Aug	6.28	0	0.00	15.99	0	0.00	15	0.94	1	0.06
27 Aug	7.28	0	0.00	10.91	0	0.00	38	3.48	0	0.00
28 Aug	5.10	0	0.00	19.10	0	0.00	8	0.42	1	0.05
29 Aug	6.02	0	0.00	12.93	0	0.00	13	1.01	1	0.08
30 Aug	5.22	0	0.00	16.51	0	0.00	33	2.00	0	0.00
31 Aug	6.05	0	0.00	15.89	0	0.00	35	2.20	4	0.25
Total	1,267.74	128.00	7.87	1,544.72	1,165.00	104.35	517.00	35.23	67.00	4.30

APPENDIX C

Appendix C1.–Daily passage estimates by zone with Standard Errors (S.E.), 2007.

		Left Bank [a]		Total		Percent by Bank	
Date	Right Bank	Nearshore	Offshore	Passage	S.E.	Right	Left
31 May	2,844	0	0	2,844	279	100.0	0.0
1 Jun	2,861	4,987	4,810	12,658	1,306	22.6	77.4
2 Jun	2,437	3,599	3,813	9,849	1,138	24.7	75.3
3 Jun	1,718	3,429	4,150	9,297	1,140	18.5	81.5
4 Jun	2,055	3,220	4,192	9,467	4,459	21.7	78.3
5 Jun	1,436	3,838	3,216	8,490	3,935	16.9	83.1
6 Jun	1,505	4,743	3,080	9,328	1,551	16.1	83.9
7 Jun	1,759	2,278	2,544	6,581	2,052	26.7	73.3
8 Jun	1,477	1,743	1,741	4,961	1,669	29.8	70.2
9 Jun	2,309	2,083	1,648	6,040	1,588	38.2	61.8
10 Jun	2,500	2,615	1,659	6,774	2,447	36.9	63.1
11 Jun	2,101	3,469	987	6,557	1,895	32.0	68.0
12 Jun	2,565	3,521	1,935	8,021	1,695	32.0	68.0
13 Jun	2,661	3,201	1,452	7,314	2,136	36.4	63.6
14 Jun	3,169	4,002	3,162	10,333	1,864	30.7	69.3
15 Jun	3,944	7,634	8,376	19,954	3,643	19.8	80.2
16 Jun	11,458	17,974	10,117	39,549	5,728	29.0	71.0
17 Jun	30,806	44,394	33,825	109,025	9,539	28.3	71.7
18 Jun	22,149	30,797	48,657	101,603	23,796	21.8	78.2
19 Jun	24,798	22,786	42,712	90,296	11,588	27.5	72.5
20 Jun	24,614	20,709	33,833	79,156	10,792	31.1	68.9
21 Jun	14,871	10,201	18,369	43,441	7,857	34.2	65.8
22 Jun	16,181	9,184	14,616	39,981	4,200	40.5	59.5
23 Jun	19,309	14,317	23,000	56,626	8,393	34.1	65.9
24 Jun	26,838	18,632	35,706	81,176	10,155	33.1	66.9
25 Jun	21,458	11,782	40,885	74,125	7,574	29.0	71.1
26 Jun	36,358	16,586	34,009	86,953	8,965	41.8	58.2
27 Jun	24,891	13,134	35,247	73,272	6,145	34.0	66.0
28 Jun	31,962	14,345	47,856	94,163	6,792	33.9	66.1
29 Jun	37,125	9,477	56,544	103,146	12,415	36.0	64.0
30 Jun	46,388	10,908	53,047	110,343	9,521	42.0	58.0
1 Jul	36,576	15,476	67,857	119,909	34,987	30.5	69.5
2 Jul	30,717	12,897	41,356	84,970	10,494	36.2	63.9
3 Jul	23,151	7,424	18,463	49,038	7,805	47.2	52.8
4 Jul	21,622	9,871	23,921	55,414	8,603	39.0	61.0
5 Jul	33,772	17,287	48,651	99,710	16,045	33.9	66.1
6 Jul	29,675	18,561	51,304	99,540	16,663	29.8	70.2
7 Jul	25,271	16,454	39,415	81,140	10,570	31.1	68.9
8 Jul	20,671	11,242	17,753	49,666	7,476	41.6	58.4
9 Jul	19,030	21,236	21,244	61,510	6,457	30.9	69.1
10 Jul	30,601	20,348	27,241	78,190	22,734	39.1	60.9
11 Jul	29,986	20,252	23,688	73,926	9,608	40.6	59.4
12 Jul	19,701	15,541	15,945	51,187	8,268	38.5	61.5
13 Jul	21,586	18,102	23,405	63,093	3,793	34.2	65.8
14 Jul	21,928	16,150	23,384	61,462	14,271	35.7	64.3
15 Jul	13,751	12,165	8,656	34,572	5,356	39.8	60.2
16 Jul	7,925	9,022	5,290	22,237	4,734	35.6	64.4
17 Jul	11,056	10,271	10,003	31,330	6,677	35.3	64.7
18 Jul	16,454	10,871	10,329	37,654	7,775	43.7	56.3

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Appendix C1.–Page 2 of 2.

Date	Right Bank	Left Bank Nearshore	Left Bank Offshore	Total Passage	S.E.	Percent by Bank Right	Percent by Bank Left
19 Jul	14,747	12,957	3,239	30,943	2,052	47.7	52.3
20 Jul	9,078	14,826	1,648	25,552	7,640	35.5	64.5
21 Jul	8,063	12,221	1,235	21,519	1,869	37.5	62.5
22 Jul	6,957	11,859	1,760	20,576	6,685	33.8	66.2
23 Jul	5,105	12,171	1,631	18,907	2,729	27.0	73.0
24 Jul	3,088	10,401	2,016	15,505	3,058	19.9	80.1
25 Jul	2,330	10,861	2,797	15,988	4,694	14.6	85.4
26 Jul	2,250	8,688	3,010	13,948	1,416	16.1	83.9
27 Jul	2,961	7,988	1,528	12,477	3,026	23.7	76.3
28 Jul	2,638	11,168	4,446	18,252	2,960	14.5	85.6
29 Jul	2,965	11,641	5,328	19,934	1,200	14.9	85.1
30 Jul	3,989	12,221	7,175	23,385	2,597	17.1	82.9
31 Jul	5,062	11,426	10,865	27,353	4,170	18.5	81.5
1 Aug	3,984	10,785	8,927	23,696	5,285	16.8	83.2
2 Aug	2,967	8,648	6,665	18,280	2,758	16.2	83.8
3 Aug	2,453	7,622	5,352	15,427	1,635	15.9	84.1
4 Aug	4,287	7,110	7,489	18,886	2,305	22.7	77.3
5 Aug	5,223	9,046	11,332	25,601	9,234	20.4	79.6
6 Aug	4,527	6,115	4,368	15,010	2,362	30.2	69.8
7 Aug	4,210	6,241	1,040	11,491	1,081	36.6	63.4
8 Aug	10,586	6,027	16,970	33,583	10,789	31.5	68.5
9 Aug	17,851	17,279	109,328	144,458	9,465	12.4	87.6
10 Aug	12,250	15,417	96,201	123,868	11,565	9.9	90.1
11 Aug	11,659	9,674	32,920	54,253	5,474	21.5	78.5
12 Aug	9,258	7,589	11,701	28,548	5,027	32.4	67.6
13 Aug	9,013	7,954	13,048	30,015	3,223	30.0	70.0
14 Aug	9,855	8,306	16,016	34,177	3,781	28.8	71.2
15 Aug	19,936	15,440	79,752	115,128	15,723	17.3	82.7
16 Aug	13,399	14,356	51,376	79,131	12,959	16.9	83.1
17 Aug	10,646	12,344	24,100	47,090	8,940	22.6	77.4
18 Aug	8,558	5,883	4,449	18,890	2,043	45.3	54.7
19 Aug	7,157	4,375	1,992	13,524	2,897	52.9	47.1
20 Aug	6,464	4,351	2,572	13,387	2,863	48.3	51.7
21 Aug	5,915	6,099	3,194	15,208	2,120	38.9	61.1
22 Aug	5,220	7,055	6,321	18,596	4,420	28.1	71.9
23 Aug	4,980	6,917	4,272	16,169	3,984	30.8	69.2
24 Aug	3,313	6,198	1,898	11,409	2,903	29.0	71.0
25 Aug	3,191	6,679	2,049	11,919	2,060	26.8	73.2
26 Aug	8,530	11,845	14,706	35,081	8,386	24.3	75.7
27 Aug	21,543	15,726	14,432	51,701	10,603	41.7	58.3
28 Aug	12,896	10,404	1,592	24,892	9,647	51.8	48.2
29 Aug	9,889	7,988	2,008	19,885	6,945	49.7	50.3
30 Aug	12,930	8,364	3,892	25,186	7,404	51.3	48.7
31 Aug	12,601	11,337	8,116	32,054	3,997	39.3	60.7
Total	1,184,544	1,014,360	1,667,849	3,866,753			

[a] Reduced detection caused by a reverberation band on the left bank necessitated partial interpolation of the estimates generated on August 15 and 16, 2007.

APPENDIX D

Appendix D1.–Daily passage estimates by species, 2007.

Date	Large Chinook	Small Chinook	All Chinook	Chum Summer	Chum Fall	Pink	Coho	Other	Total
31 May	0	0	0	0	0	0	0	2,844	2,844
1 Jun	0	0	0	0	0	0	0	12,658	12,658
2 Jun	0	0	0	0	0	0	0	9,849	9,849
3 Jun	0	0	0	0	0	0	0	9,297	9,297
4 Jun	0	0	0	1,066	0	0	0	8,401	9,467
5 Jun	0	0	0	818	0	0	0	7,672	8,490
6 Jun	685	0	685	0	0	0	0	8,643	9,328
7 Jun	2,043	0	2,043	0	0	0	0	4,538	6,581
8 Jun	457	0	457	840	0	0	0	3,664	4,961
9 Jun	288	0	288	795	0	0	0	4,957	6,040
10 Jun	1,111	724	1,835	1,093	0	0	0	3,846	6,774
11 Jun	327	227	554	2,106	0	0	0	3,897	6,557
12 Jun	388	328	716	3,281	0	0	0	4,024	8,021
13 Jun	1,031	0	1,031	2,894	0	0	0	3,389	7,314
14 Jun	217	415	632	4,188	0	0	0	5,513	10,333
15 Jun	2,097	595	2,692	14,703	0	0	0	2,559	19,954
16 Jun	4,007	1,129	5,136	27,552	0	0	0	6,861	39,549
17 Jun	6,059	1,826	7,885	95,787	0	0	0	5,353	109,025
18 Jun	3,999	1,117	5,116	71,878	0	0	0	24,609	101,603
19 Jun	6,384	3,400	9,784	74,154	0	0	0	6,358	90,296
20 Jun	5,433	2,979	8,412	64,793	0	0	0	5,951	79,156
21 Jun	2,955	1,642	4,597	35,411	0	0	0	3,433	43,441
22 Jun	1,573	932	2,505	33,660	0	0	0	3,816	39,981
23 Jun	2,935	281	3,216	50,825	0	0	0	2,585	56,626
24 Jun	4,474	365	4,839	72,648	0	0	0	3,689	81,176
25 Jun	3,580	190	3,770	69,447	0	0	0	908	74,125
26 Jun	3,493	268	3,761	81,653	0	0	0	1,539	86,953
27 Jun	2,152	1,140	3,292	69,878	0	0	0	102	73,272
28 Jun	2,883	1,457	4,340	89,712	0	0	0	111	94,163
29 Jun	332	0	332	101,823	0	0	0	991	103,146
30 Jun	8,004	397	8,401	91,023	0	0	0	10,919	110,343
1 Jul	4,080	3,096	7,176	73,213	0	0	0	39,520	119,909
2 Jul	3,837	5,753	9,590	66,960	0	264	0	8,156	84,970
3 Jul	1,921	3,340	5,261	38,299	0	199	0	5,279	49,038
4 Jul	1,251	833	2,084	34,721	0	0	0	18,609	55,414
5 Jul	2,827	350	3,177	80,986	0	0	0	15,547	99,710
6 Jul	871	0	871	68,690	0	317	0	29,662	99,540
7 Jul	999	328	1,327	33,380	0	261	0	46,172	81,140
8 Jul	763	203	966	22,235	0	213	0	26,252	49,666
9 Jul	768	378	1,146	18,814	0	0	0	41,550	61,510
10 Jul	1,012	0	1,012	40,042	0	0	0	37,136	78,190
11 Jul	642	779	1,421	34,016	0	428	0	38,061	73,926
12 Jul	1,281	0	1,281	21,221	0	284	0	28,401	51,187
13 Jul	842	150	992	45,750	0	309	0	16,042	63,093
14 Jul	0	436	436	26,687	0	2,098	0	32,241	61,462
15 Jul	548	0	548	14,548	0	0	0	19,476	34,572
16 Jul	129	0	129	8,013	0	1,970	0	12,125	22,237
17 Jul	59	0	59	14,994	0	2,075	0	14,202	31,330
18 Jul	0	0	0	22,288	0	6,580	0	8,786	37,654

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Date	Large Chinook	Small Chinook	All Chinook	Chum Summer	Chum Fall	Pink	Coho	Other	Total
19 Jul	0	0	0	0	19,920	7,084	0	3,939	30,943
20 Jul	134	210	344	0	9,056	5,154	0	10,998	25,552
21 Jul	122	0	122	0	9,606	2,084	271	9,436	21,519
22 Jul	0	0	0	0	4,970	4,194	170	11,242	20,576
23 Jul	361	0	361	0	6,239	5,700	189	6,418	18,907
24 Jul	0	0	0	0	1,928	6,761	410	6,406	15,505
25 Jul	512	0	512	0	1,876	3,567	0	10,033	15,988
26 Jul	69	0	69	0	1,528	1,878	65	10,408	13,948
27 Jul	0	0	0	0	2,845	2,964	168	6,500	12,477
28 Jul	0	0	0	0	3,418	3,298	173	11,363	18,252
29 Jul	0	101	101	0	2,168	306	100	17,259	19,934
30 Jul	0	0	0	0	7,788	777	535	14,285	23,385
31 Jul	0	0	0	0	12,667	553	99	14,034	27,353
1 Aug	0	0	0	0	6,778	1,790	949	14,179	23,696
2 Aug	0	0	0	0	4,306	513	1,673	11,788	18,280
3 Aug	0	0	0	0	4,880	359	1,805	8,383	15,427
4 Aug	0	0	0	0	10,709	898	760	6,519	18,886
5 Aug	0	0	0	0	8,874	468	2,639	13,620	25,601
6 Aug	0	0	0	0	2,319	1,548	2,541	8,602	15,010
7 Aug	0	0	0	0	831	338	1,729	8,593	11,491
8 Aug	0	0	0	0	22,437	1,819	2,914	6,413	33,583
9 Aug	0	0	0	0	123,185	420	7,569	13,284	144,458
10 Aug	0	0	0	0	91,991	1,486	12,158	18,233	123,868
11 Aug	0	0	0	0	24,758	0	19,176	10,319	54,253
12 Aug	0	0	0	0	6,752	0	13,291	8,505	28,548
13 Aug	0	0	0	0	12,839	648	9,452	7,076	30,015
14 Aug	0	0	0	0	16,880	262	8,387	8,648	34,177
15 Aug	149	0	149	0	85,911	283	8,387	20,398	115,128
16 Aug	100	0	100	0	57,178	264	5,793	15,796	79,131
17 Aug	0	0	0	0	17,573	569	17,185	11,763	47,090
18 Aug	0	0	0	0	5,250	0	8,021	5,619	18,890
19 Aug	0	0	0	0	2,507	0	4,405	6,612	13,524
20 Aug	0	0	0	0	2,710	0	4,095	6,582	13,387
21 Aug	0	0	0	0	1,269	0	3,861	10,078	15,208
22 Aug	0	0	0	0	5,451	362	2,831	9,952	18,596
23 Aug	0	0	0	0	3,856	305	2,500	9,508	16,169
24 Aug	0	0	0	0	1,872	49	1,034	8,454	11,409
25 Aug	0	0	0	0	1,434	0	1,573	8,912	11,919
26 Aug	0	0	0	0	17,659	0	1,647	15,775	35,081
27 Aug	0	0	0	0	21,596	0	3,492	26,613	51,701
28 Aug	0	0	0	0	3,972	0	6,487	14,433	24,892
29 Aug	0	0	0	0	8,292	0	3,274	8,319	19,885
30 Aug	0	0	0	0	11,343	0	4,316	9,527	25,186
31 Aug	0	0	0	0	14,590	0	7,165	10,299	32,054
Total	90,184	35,369	125,553	1,726,885	684,011	71,699	173,289	1,085,316	3,866,753

APPENDIX E

Appendix E1.–Estimates of daily passage in sectors 1 & 2 of Strata 3 on left bank. This is the DIDSON generated component of the left bank nearshore estimates listed in Appendix C1, 2007.

Date	Large Chinook	Small Chinook	Total Chinook	Summer Chum	Fall Chum	Pink	Coho	Other
1 Jun	0	0	0	0	0	0	0	1,681
2 Jun	0	0	0	0	0	0	0	1,423
3 Jun	0	0	0	0	0	0	0	977
4 Jun	0	0	0	0	0	0	0	582
5 Jun	0	0	0	0	0	0	0	424
6 Jun	0	0	0	0	0	0	0	464
7 Jun	631	0	631	0	0	0	0	342
8 Jun	68	0	68	0	0	0	0	623
9 Jun	6	0	6	0	0	0	0	724
10 Jun	207	210	417	0	0	0	0	342
11 Jun	0	0	0	1,070	0	0	0	967
12 Jun	0	0	0	817	0	0	0	564
13 Jun	252	0	252	614	0	0	0	528
14 Jun	0	0	0	378	0	0	0	904
15 Jun	270	74	344	1,364	0	0	0	270
16 Jun	310	85	395	1,565	0	0	0	309
17 Jun	259	60	318	4,881	0	0	0	244
18 Jun	66	45	112	1,422	0	0	0	1,527
19 Jun	227	131	358	3,345	0	0	0	155
20 Jun	233	134	366	3,423	0	0	0	159
21 Jun	126	73	199	1,860	0	0	0	86
22 Jun	0	26	26	1,175	0	0	0	703
23 Jun	56	81	136	3,980	0	0	0	0
24 Jun	30	44	74	2,168	0	0	0	0
25 Jun	155	43	199	2,471	0	0	0	0
26 Jun	124	34	158	1,965	0	0	0	0
27 Jun	15	39	54	1,849	0	0	0	15
28 Jun	10	26	36	1,219	0	0	0	10
29 Jun	0	0	0	847	0	0	0	38
30 Jun	43	48	91	908	0	0	0	326
1 Jul	0	35	35	1,356	0	0	0	66
2 Jul	0	430	430	609	0	0	0	209
3 Jul	0	546	546	774	0	0	0	265
4 Jul	0	0	0	234	0	0	0	1,245
5 Jul	0	0	0	2,322	0	0	0	1,109
6 Jul	0	0	0	526	0	0	0	2,955
7 Jul	0	0	0	198	0	0	0	1,584
8 Jul	0	0	0	195	0	0	0	1,560
9 Jul	0	33	33	306	0	0	0	3,578
10 Jul	0	0	0	1,445	0	0	0	1,591
11 Jul	0	0	0	338	0	0	0	2,962
12 Jul	0	0	0	0	0	0	0	2,901
13 Jul	0	0	0	558	0	0	0	2,488
14 Jul	0	81	81	342	0	426	0	3,166
15 Jul	30	0	30	147	0	0	0	2,276
16 Jul	0	0	0	161	0	265	0	788
17 Jul	0	0	0	163	0	146	0	849
18 Jul	0	0	0	200	0	374	0	192

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Date	Large Chinook	Small Chinook	Total Chinook	Summer Chum	Fall Chum	Pink	Coho	Other
19 Jul	0	0	0	0	291	498	0	161
20 Jul	0	24	24	0	126	532	0	1,032
21 Jul	0	0	0	0	200	149	0	1,150
22 Jul	0	0	0	0	28	273	0	550
23 Jul	0	0	0	0	251	734	0	594
24 Jul	0	0	0	0	91	1,051	66	905
25 Jul	0	0	0	0	71	540	0	1,499
26 Jul	0	0	0	0	125	368	0	1,210
27 Jul	0	0	0	0	421	1,330	0	2,589
28 Jul	0	0	0	0	0	1,393	0	3,414
29 Jul	0	0	0	0	128	0	0	3,618
30 Jul	0	0	0	0	0	211	0	3,674
31 Jul	0	0	0	0	300	0	0	3,205
1 Aug	0	0	0	0	243	570	0	2,621
2 Aug	0	0	0	0	113	94	0	2,554
3 Aug	0	0	0	0	132	111	0	2,787
4 Aug	0	0	0	0	472	243	0	1,468
5 Aug	0	0	0	0	552	87	0	1,430
6 Aug	0	0	0	0	0	353	70	1,740
7 Aug	0	0	0	0	50	107	67	1,746
8 Aug	0	0	0	0	620	286	0	1,745
9 Aug	0	0	0	0	1,183	104	74	2,926
10 Aug	0	0	0	0	308	339	0	3,666
11 Aug	0	0	0	0	273	0	97	2,735
12 Aug	0	0	0	0	0	0	428	1,873
13 Aug	0	0	0	0	196	200	256	1,807
14 Aug	0	0	0	0	282	98	295	2,428
15 Aug	0	0	0	0	478	25	66	800
16 Aug	0	0	0	0	998	52	138	1,670
17 Aug	0	0	0	0	767	139	83	2,018
18 Aug	0	0	0	0	66	0	0	1,408
19 Aug	0	0	0	0	427	0	177	1,011
20 Aug	0	0	0	0	493	0	204	1,166
21 Aug	0	0	0	0	0	0	0	2,358
22 Aug	0	0	0	0	69	58	167	1,785
23 Aug	0	0	0	0	88	75	214	2,285
24 Aug	0	0	0	0	88	0	0	2,032
25 Aug	0	0	0	0	0	0	0	2,047
26 Aug	0	0	0	0	446	0	0	1,848
27 Aug	0	0	0	0	533	0	0	2,209
28 Aug	0	0	0	0	0	0	458	1,862
29 Aug	0	0	0	0	653	0	0	1,207
30 Aug	0	0	0	0	592	0	0	1,094
31 Aug	0	0	0	0	158	0	232	1,878
Season Total	3,118	2,302	5,419	47,195	12,312	11,231	3,092	127,976

Appendix E2.–Percent by species, of daily total passage (both banks combined) for sectors 1 & 2 of Strata 3 of the left bank nearshore region generated by the DIDSON, 2007.

Date	Large Chinook	Small Chinook	Total Chinook	Summer Chum	Fall Chum	Pink	Coho	Other	Daily Total
1 Jun		-	-	-		-	-	0.13	0.13
2 Jun	-	-	-	-		-	-	0.14	0.14
3 Jun	-	-	-	-		-	-	0.11	0.11
4 Jun	-	-	-	-		-	-	0.07	0.06
5 Jun	-	-	-	-		-	-	0.06	0.05
6 Jun	-	-	-	-		-	-	0.05	0.05
7 Jun	0.31	-	0.31	-		-	-	0.08	0.15
8 Jun	0.15	-	0.15	-		-	-	0.17	0.14
9 Jun	0.02	-	0.02	-		-	-	0.15	0.12
10 Jun	0.19	0.29	0.23	-		-	-	0.09	0.11
11 Jun	-	-	-	0.51		-	-	0.25	0.31
12 Jun	-	-	-	0.25		-	-	0.14	0.17
13 Jun	0.24	-	0.24	0.21		-	-	0.16	0.19
14 Jun	-	-	-	0.09		-	-	0.16	0.12
15 Jun	0.13	0.12	0.13	0.09		-	-	0.11	0.10
16 Jun	0.08	0.08	0.08	0.06		-	-	0.05	0.06
17 Jun	0.04	0.03	0.04	0.05		-	-	0.05	0.05
18 Jun	0.02	0.04	0.02	0.02		-	-	0.06	0.03
19 Jun	0.04	0.04	0.04	0.05		-	-	0.02	0.04
20 Jun	0.04	0.04	0.04	0.05		-	-	0.03	0.05
21 Jun	0.04	0.04	0.04	0.05		-	-	0.03	0.05
22 Jun	-	0.03	0.01	0.03		-	-	0.18	0.05
23 Jun	0.02	0.29	0.04	0.08		-	-	-	0.07
24 Jun	0.01	0.12	0.02	0.03		-	-	-	0.03
25 Jun	0.04	0.23	0.05	0.04		-	-	-	0.04
26 Jun	0.04	0.13	0.04	0.02		-	-	-	0.02
27 Jun	0.01	0.03	0.02	0.03		-	-	0.15	0.03
28 Jun	0.00	0.02	0.01	0.01		-	-	0.09	0.01
29 Jun	-	-	-	0.01		-	-	0.04	0.01
30 Jun	0.01	0.12	0.01	0.01		-	-	0.03	0.01
1 Jul	-	0.01	0.00	0.02		-	-	0.00	0.01
2 Jul	-	0.07	0.04	0.01		-	-	0.03	0.01
3 Jul	-	0.16	0.10	0.02		-	-	0.05	0.03
4 Jul	-	-	-	0.01		-	-	0.07	0.03
5 Jul	-	-	-	0.03		-	-	0.07	0.03
6 Jul	-	-	-	0.01		-	-	0.10	0.03
7 Jul	-	-	-	0.01		-	-	0.03	0.02
8 Jul	-	-	-	0.01		-	-	0.06	0.04
9 Jul	-	0.09	0.03	0.02		-	-	0.09	0.06
10 Jul	-	-	-	0.04		-	-	0.04	0.04
11 Jul	-	-	-	0.01		-	-	0.08	0.04
12 Jul	-	-	-	-		-	-	0.10	0.06
13 Jul	-	-	-	0.01		-	-	0.16	0.05
14 Jul	-	0.19	0.19	0.01		0.20	-	0.10	0.07
15 Jul	0.05	-	0.05	0.01		-	-	0.12	0.07
16 Jul	-	-	-	0.02		0.13	-	0.06	0.05
17 Jul	-	-	-	0.01		0.07	-	0.06	0.04
18 Jul	-	-	-	0.01		0.06	-	0.02	0.02

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Date	Large Chinook	Small Chinook	Total Chinook	Summer Chum	Fall Chum	Pink	Coho	Other	Daily Total
19 Jul	-	-	-		0.01	0.07	-	0.04	0.03
20 Jul	-	0.11	0.07		0.01	0.10	-	0.09	0.07
21 Jul	-	-	-		0.02	0.07	-	0.12	0.07
22 Jul	-	-	-		0.01	0.07	-	0.05	0.04
23 Jul	-	-	-		0.04	0.13	-	0.09	0.08
24 Jul	-	-	-		0.05	0.16	0.16	0.14	0.14
25 Jul	-	-	-		0.04	0.15	-	0.15	0.13
26 Jul	-	-	-		0.08	0.20	-	0.12	0.12
27 Jul	-	-	-		0.15	0.45	-	0.40	0.35
28 Jul	-	-	-		-	0.42	-	0.30	0.26
29 Jul	-	-	-		0.06	-	-	0.21	0.19
30 Jul	-	-	-		-	0.27	-	0.26	0.17
31 Jul	-	-	-		0.02	-	-	0.23	0.13
1 Aug	-	-	-		0.04	0.32	-	0.18	0.14
2 Aug	-	-	-		0.03	0.18	-	0.22	0.15
3 Aug	-	-	-		0.03	0.31	-	0.33	0.20
4 Aug	-	-	-		0.04	0.27	-	0.23	0.12
5 Aug	-	-	-		0.06	0.19	-	0.10	0.08
6 Aug	-	-	-		-	0.23	0.03	0.20	0.14
7 Aug	-	-	-		0.06	0.32	0.04	0.20	0.17
8 Aug	-	-	-		0.03	0.16	-	0.27	0.08
9 Aug	-	-	-		0.01	0.25	0.01	0.22	0.03
10 Aug	-	-	-		0.00	0.23	-	0.20	0.03
11 Aug	-	-	-		0.01	-	0.01	0.27	0.06
12 Aug	-	-	-		-	-	0.03	0.22	0.08
13 Aug	-	-	-		0.02	0.31	0.03	0.26	0.08
14 Aug	-	-	-		0.02	0.37	0.04	0.28	0.09
15 Aug	-	-	-		0.01	0.09	0.01	0.04	0.01
16 Aug	-	-	-		0.02	0.20	0.02	0.11	0.04
17 Aug	-	-	-		0.04	0.24	0.00	0.17	0.06
18 Aug	-	-	-		0.01	-	-	0.25	0.08
19 Aug	-	-	-		0.17	-	0.04	0.15	0.12
20 Aug	-	-	-		0.18	-	0.05	0.18	0.14
21 Aug	-	-	-		-	-	-	0.23	0.16
22 Aug	-	-	-		0.01	0.16	0.06	0.18	0.11
23 Aug	-	-	-		0.02	0.25	0.09	0.24	0.16
24 Aug	-	-	-		0.05	-	-	0.24	0.19
25 Aug	-	-	-		-	-	-	0.23	0.17
26 Aug	-	-	-		0.03	-	-	0.12	0.07
27 Aug	-	-	-		0.02	-	-	0.08	0.05
28 Aug	-	-	-		-	-	0.07	0.13	0.09
29 Aug	-	-	-		0.08	-	-	0.15	0.09
30 Aug	-	-	-		0.05	-	-	0.11	0.07
31 Aug	-	-	-		0.01	-	0.03	0.18	0.07
Season Total	0.035	0.065	0.043	0.027	0.018	0.157	0.018	0.118	0.054

APPENDIX F

Appendix F1.–Daily cumulative passage estimates by species, 2007.

Date	Large Chinook	Small Chinook	Total Chinook	Summer Chum	Fall Chum	Pink	Coho	Other	All Species Total
31 May	0	0	0	0		0	0	2,844	2,844
1 Jun	0	0	0	0		0	0	15,502	15,502
2 Jun	0	0	0	0		0	0	25,351	25,351
3 Jun	0	0	0	0		0	0	34,648	34,648
4 Jun	0	0	0	1,066		0	0	43,049	44,115
5 Jun	0	0	0	1,884		0	0	50,722	52,606
6 Jun	685	0	685	1,884		0	0	59,365	61,934
7 Jun	2,728	0	2,728	1,884		0	0	63,903	68,515
8 Jun	3,185	0	3,185	2,724		0	0	67,567	73,476
9 Jun	3,473	0	3,473	3,519		0	0	72,524	79,516
10 Jun	4,584	724	5,308	4,612		0	0	76,370	86,290
11 Jun	4,911	951	5,862	6,718		0	0	80,267	92,847
12 Jun	5,299	1,279	6,578	9,999		0	0	84,291	100,868
13 Jun	6,330	1,279	7,609	12,893		0	0	87,680	108,182
14 Jun	6,547	1,694	8,241	17,081		0	0	93,193	118,515
15 Jun	8,644	2,289	10,933	31,784		0	0	95,752	138,469
16 Jun	12,651	3,418	16,069	59,336		0	0	102,613	178,018
17 Jun	18,710	5,244	23,954	155,123		0	0	107,966	287,043
18 Jun	22,709	6,361	29,070	227,001		0	0	132,575	388,646
19 Jun	29,093	9,761	38,854	301,155		0	0	138,933	478,942
20 Jun	34,526	12,740	47,266	365,948		0	0	144,884	558,098
21 Jun	37,481	14,382	51,863	401,359		0	0	148,317	601,539
22 Jun	39,054	15,314	54,368	435,019		0	0	152,133	641,520
23 Jun	41,989	15,595	57,584	485,844		0	0	154,718	698,146
24 Jun	46,463	15,960	62,423	558,492		0	0	158,407	779,322
25 Jun	50,043	16,150	66,193	627,939		0	0	159,315	853,447
26 Jun	53,536	16,418	69,954	709,592		0	0	160,854	940,400
27 Jun	55,688	17,558	73,246	779,470		0	0	160,956	1,013,672
28 Jun	58,571	19,015	77,586	869,182		0	0	161,067	1,107,835
29 Jun	58,903	19,015	77,918	971,005		0	0	162,058	1,210,981
30 Jun	66,907	19,412	86,319	1,062,028		0	0	172,977	1,321,324
1 Jul	70,987	22,508	93,495	1,135,241		0	0	212,497	1,441,233
2 Jul	74,824	28,261	103,085	1,202,201		264	0	220,653	1,526,203
3 Jul	76,745	31,601	108,346	1,240,500		463	0	225,932	1,575,241
4 Jul	77,996	32,434	110,430	1,275,221		463	0	244,541	1,630,655
5 Jul	80,823	32,784	113,607	1,356,207		463	0	260,088	1,730,365
6 Jul	81,694	32,784	114,478	1,424,897		780	0	289,750	1,829,905
7 Jul	82,693	33,112	115,805	1,458,277		1,041	0	335,922	1,911,045
8 Jul	83,456	33,315	116,771	1,480,512		1,254	0	362,174	1,960,711
9 Jul	84,224	33,693	117,917	1,499,326		1,254	0	403,724	2,022,221
10 Jul	85,236	33,693	118,929	1,539,368		1,254	0	440,860	2,100,411
11 Jul	85,878	34,472	120,350	1,573,384		1,682	0	478,921	2,174,337
12 Jul	87,159	34,472	121,631	1,594,605		1,966	0	507,322	2,225,524
13 Jul	88,001	34,622	122,623	1,640,355		2,275	0	523,364	2,288,617
14 Jul	88,001	35,058	123,059	1,667,042		4,373	0	555,605	2,350,079
15 Jul	88,549	35,058	123,607	1,681,590		4,373	0	575,081	2,384,651
16 Jul	88,678	35,058	123,736	1,689,603		6,343	0	587,206	2,406,888
17 Jul	88,737	35,058	123,795	1,704,597		8,418	0	601,408	2,438,218
18 Jul	88,737	35,058	123,795	1,726,885		14,998	0	610,194	2,475,872

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Appendix F1.–Page 2 of 2.

Date	Large Chinook	Small Chinook	Total Chinook	Summer Chum	Fall Chum	Pink	Coho	Other	All Species Total
19 Jul	88,737	35,058	123,795		19,920	22,082	0	614,133	2,506,815
20 Jul	88,871	35,268	124,139		28,976	27,236	0	625,131	2,532,367
21 Jul	88,993	35,268	124,261		38,582	29,320	271	634,567	2,553,886
22 Jul	88,993	35,268	124,261		43,552	33,514	441	645,809	2,574,462
23 Jul	89,354	35,268	124,622		49,791	39,214	630	652,227	2,593,369
24 Jul	89,354	35,268	124,622		51,719	45,975	1,040	658,633	2,608,874
25 Jul	89,866	35,268	125,134		53,595	49,542	1,040	668,666	2,624,862
26 Jul	89,935	35,268	125,203		55,123	51,420	1,105	679,074	2,638,810
27 Jul	89,935	35,268	125,203		57,968	54,384	1,273	685,574	2,651,287
28 Jul	89,935	35,268	125,203		61,386	57,682	1,446	696,937	2,669,539
29 Jul	89,935	35,369	125,304		63,554	57,988	1,546	714,196	2,689,473
30 Jul	89,935	35,369	125,304		71,342	58,765	2,081	728,481	2,712,858
31 Jul	89,935	35,369	125,304		84,009	59,318	2,180	742,515	2,740,211
1 Aug	89,935	35,369	125,304		90,787	61,108	3,129	756,694	2,763,907
2 Aug	89,935	35,369	125,304		95,093	61,621	4,802	768,482	2,782,187
3 Aug	89,935	35,369	125,304		99,973	61,980	6,607	776,865	2,797,614
4 Aug	89,935	35,369	125,304		110,682	62,878	7,367	783,384	2,816,500
5 Aug	89,935	35,369	125,304		119,556	63,346	10,006	797,004	2,842,101
6 Aug	89,935	35,369	125,304		121,875	64,894	12,547	805,606	2,857,111
7 Aug	89,935	35,369	125,304		122,706	65,232	14,276	814,199	2,868,602
8 Aug	89,935	35,369	125,304		145,143	67,051	17,190	820,612	2,902,185
9 Aug	89,935	35,369	125,304		268,328	67,471	24,759	833,896	3,046,643
10 Aug	89,935	35,369	125,304		360,319	68,957	36,917	852,129	3,170,511
11 Aug	89,935	35,369	125,304		385,077	68,957	56,093	862,448	3,224,764
12 Aug	89,935	35,369	125,304		391,829	68,957	69,384	870,953	3,253,312
13 Aug	89,935	35,369	125,304		404,668	69,605	78,836	878,029	3,283,327
14 Aug	89,935	35,369	125,304		421,548	69,867	87,223	886,677	3,317,504
15 Aug	90,084	35,369	125,453		507,459	70,150	95,610	907,075	3,432,632
16 Aug	90,184	35,369	125,553		564,637	70,414	101,403	922,871	3,511,763
17 Aug	90,184	35,369	125,553		582,210	70,983	118,588	934,634	3,558,853
18 Aug	90,184	35,369	125,553		587,460	70,983	126,609	940,253	3,577,743
19 Aug	90,184	35,369	125,553		589,967	70,983	131,014	946,865	3,591,267
20 Aug	90,184	35,369	125,553		592,677	70,983	135,109	953,447	3,604,654
21 Aug	90,184	35,369	125,553		593,946	70,983	138,970	963,525	3,619,862
22 Aug	90,184	35,369	125,553		599,397	71,345	141,801	973,477	3,638,458
23 Aug	90,184	35,369	125,553		603,253	71,650	144,301	982,985	3,654,627
24 Aug	90,184	35,369	125,553		605,125	71,699	145,335	991,439	3,666,036
25 Aug	90,184	35,369	125,553		606,559	71,699	146,908	1,000,351	3,677,955
26 Aug	90,184	35,369	125,553		624,218	71,699	148,555	1,016,126	3,713,036
27 Aug	90,184	35,369	125,553		645,814	71,699	152,047	1,042,739	3,764,737
28 Aug	90,184	35,369	125,553		649,786	71,699	158,534	1,057,172	3,789,629
29 Aug	90,184	35,369	125,553		658,078	71,699	161,808	1,065,491	3,809,514
30 Aug	90,184	35,369	125,553		669,421	71,699	166,124	1,075,018	3,834,700
31 Aug	90,184	35,369	125,553		684,011	71,699	173,289	1,085,317	3,866,754

Note: Estimates for fall chum, coho salmon and other species are considered conservative and may not include the entire run.

Appendix F2.–Daily cumulative run proportions and timing by species, 2007. 25th, 50th, and 75th percentile are in bold.

Date	Large Chinook	Small Chinook	Total Chinook	Summer Chum	Fall Chum	Pink	Coho	Other	All Species Total
31 May	-	-	-	-	-	-	-	0.00	2,844
1 Jun	-	-	-	-	-	-	-	0.01	15,502
2 Jun	-	-	-	-	-	-	-	0.02	25,351
3 Jun	-	-	-	-	-	-	-	0.03	34,648
4 Jun	-	-	-	0.00	-	-	-	0.04	44,115
5 Jun	-	-	-	0.00	-	-	-	0.05	52,606
6 Jun	0.01	-	0.01	0.00	-	-	-	0.05	61,934
7 Jun	0.03	-	0.02	0.00	-	-	-	0.06	68,515
8 Jun	0.04	-	0.03	0.00	-	-	-	0.06	73,476
9 Jun	0.04	-	0.03	0.00	-	-	-	0.07	79,516
10 Jun	0.05	0.02	0.04	0.00	-	-	-	0.07	86,290
11 Jun	0.05	0.03	0.05	0.00	-	-	-	0.07	92,847
12 Jun	0.06	0.04	0.05	0.01	-	-	-	0.08	100,868
13 Jun	0.07	0.04	0.06	0.01	-	-	-	0.08	108,182
14 Jun	0.07	0.05	0.07	0.01	-	-	-	0.09	118,515
15 Jun	0.10	0.06	0.09	0.02	-	-	-	0.09	138,469
16 Jun	0.14	0.10	0.13	0.03	-	-	-	0.09	178,018
17 Jun	0.21	0.15	0.19	0.09	-	-	-	0.10	287,043
18 Jun	**0.25**	0.18	0.23	0.13	-	-	-	0.12	388,646
19 Jun	0.32	**0.28**	**0.31**	0.17	-	-	-	0.13	478,942
20 Jun	0.38	0.36	0.38	0.21	-	-	-	0.13	558,098
21 Jun	0.42	0.41	0.41	0.23	-	-	-	0.14	601,539
22 Jun	0.43	0.43	0.43	**0.25**	-	-	-	0.14	641,520
23 Jun	0.47	0.44	0.46	0.28	-	-	-	0.14	698,146
24 Jun	**0.52**	0.45	**0.50**	0.32	-	-	-	0.15	779,322
25 Jun	0.55	0.46	0.53	0.36	-	-	-	0.15	853,447
26 Jun	0.59	0.46	0.56	0.41	-	-	-	0.15	940,400
27 Jun	0.62	**0.50**	0.58	0.45	-	-	-	0.15	1,013,672
28 Jun	0.65	0.54	0.62	**0.50**	-	-	-	0.15	1,107,835
29 Jun	0.65	0.54	0.62	0.56	-	-	-	0.15	1,210,981
30 Jun	0.74	0.55	0.69	0.61	-	-	-	0.16	1,321,324
1 Jul	**0.79**	0.64	0.74	0.66	-	-	-	0.20	1,441,233
2 Jul	0.83	**0.80**	**0.82**	0.70	-	0.00	-	0.20	1,526,203
3 Jul	0.85	0.89	0.86	0.72	-	0.01	-	0.21	1,575,241
4 Jul	0.86	0.92	0.88	0.74	-	0.01	-	0.23	1,630,655
5 Jul	0.90	0.93	0.90	**0.79**	-	0.01	-	0.24	1,730,365
6 Jul	0.91	0.93	0.91	0.83	-	0.01	-	**0.27**	1,829,905
7 Jul	0.92	0.94	0.92	0.84	-	0.01	-	0.31	1,911,045
8 Jul	0.93	0.94	0.93	0.86	-	0.02	-	0.33	1,960,711
9 Jul	0.93	0.95	0.94	0.87	-	0.02	-	0.37	2,022,221
10 Jul	0.95	0.95	0.95	0.89	-	0.02	-	0.41	2,100,411
11 Jul	0.95	0.97	0.96	0.91	-	0.02	-	0.44	2,174,337
12 Jul	0.97	0.97	0.97	0.92	-	0.03	-	0.47	2,225,524
13 Jul	0.98	0.98	0.98	0.95	-	0.03	-	0.48	2,288,617
14 Jul	0.98	0.99	0.98	0.97	-	0.06	-	**0.51**	2,350,079
15 Jul	0.98	0.99	0.98	0.97	-	0.06	-	0.53	2,384,651
16 Jul	0.98	0.99	0.99	0.98	-	0.09	-	0.54	2,406,888
17 Jul	0.98	0.99	0.99	0.99	-	0.12	-	0.55	2,438,218
18 Jul	0.98	0.99	0.99	1.00	-	0.21	-	0.56	2,475,872

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Appendix F2.–Page 2 of 2.

Date	Large Chinook	Small Chinook	Total Chinook	Summer Chum	Fall Chum	Pink	Coho	Other	All Species Total
19 Jul	0.98	0.99	0.99		0.03	**0.31**	-	0.57	2,506,815
20 Jul	0.99	1.00	0.99	-	0.04	0.38	-	0.58	2,532,367
21 Jul	0.99	1.00	0.99	-	0.06	0.41	0.00	0.58	2,553,886
22 Jul	0.99	1.00	0.99	-	0.06	0.47	0.00	0.60	2,574,462
23 Jul	0.99	1.00	0.99	-	0.07	**0.55**	0.00	0.60	2,593,369
24 Jul	0.99	1.00	0.99	-	0.08	0.64	0.01	0.61	2,608,874
25 Jul	1.00	1.00	1.00	-	0.08	0.69	0.01	0.62	2,624,862
26 Jul	1.00	1.00	1.00	-	0.08	0.72	0.01	0.63	2,638,810
27 Jul	1.00	1.00	1.00	-	0.08	**0.76**	0.01	0.63	2,651,287
28 Jul	1.00	1.00	1.00	-	0.09	0.80	0.01	0.64	2,669,539
29 Jul	1.00	1.00	1.00	-	0.09	0.81	0.01	0.66	2,689,473
30 Jul	1.00	1.00	1.00	-	0.10	0.82	0.01	0.67	2,712,858
31 Jul	1.00	1.00	1.00	-	0.12	0.83	0.01	0.68	2,740,211
1 Aug	1.00	1.00	1.00	-	0.13	0.85	0.02	0.70	2,763,907
2 Aug	1.00	1.00	1.00	-	0.14	0.86	0.03	0.71	2,782,187
3 Aug	1.00	1.00	1.00	-	0.15	0.86	0.04	0.72	2,797,614
4 Aug	1.00	1.00	1.00	-	0.16	0.88	0.04	0.72	2,816,500
5 Aug	1.00	1.00	1.00	-	0.17	0.88	0.06	0.73	2,842,101
6 Aug	1.00	1.00	1.00	-	0.18	0.91	0.07	0.74	2,857,111
7 Aug	1.00	1.00	1.00	-	0.18	0.91	0.08	**0.75**	2,868,602
8 Aug	1.00	1.00	1.00	-	0.21	0.94	0.10	0.76	2,902,185
9 Aug	1.00	1.00	1.00	-	**0.39**	0.94	0.14	0.77	3,046,643
10 Aug	1.00	1.00	1.00	-	**0.53**	0.96	0.21	0.79	3,170,511
11 Aug	1.00	1.00	1.00	-	0.56	0.96	**0.32**	0.79	3,224,764
12 Aug	1.00	1.00	1.00	-	0.57	0.96	0.40	0.80	3,253,312
13 Aug	1.00	1.00	1.00	-	0.59	0.97	0.45	0.81	3,283,327
14 Aug	1.00	1.00	1.00	-	0.62	0.97	**0.50**	0.82	3,317,504
15 Aug	1.00	1.00	1.00	-	0.74	0.98	0.55	0.84	3,432,632
16 Aug	1.00	1.00	1.00	-	**0.83**	0.98	0.59	0.85	3,511,763
17 Aug	1.00	1.00	1.00	-	0.85	0.99	0.68	0.86	3,558,853
18 Aug	1.00	1.00	1.00	-	0.86	0.99	0.73	0.87	3,577,743
19 Aug	1.00	1.00	1.00	-	0.86	0.99	**0.76**	0.87	3,591,267
20 Aug	1.00	1.00	1.00	-	0.87	0.99	0.78	0.88	3,604,654
21 Aug	1.00	1.00	1.00	-	0.87	0.99	0.80	0.89	3,619,862
22 Aug	1.00	1.00	1.00	-	0.88	1.00	0.82	0.90	3,638,458
23 Aug	1.00	1.00	1.00	-	0.88	1.00	0.83	0.91	3,654,627
24 Aug	1.00	1.00	1.00	-	0.88	1.00	0.84	0.91	3,666,036
25 Aug	1.00	1.00	1.00	-	0.89	1.00	0.85	0.92	3,677,955
26 Aug	1.00	1.00	1.00	-	0.91	1.00	0.86	0.94	3,713,036
27 Aug	1.00	1.00	1.00	-	0.94	1.00	0.88	0.96	3,764,737
28 Aug	1.00	1.00	1.00	-	0.95	1.00	0.91	0.97	3,789,629
29 Aug	1.00	1.00	1.00	-	0.96	1.00	0.93	0.98	3,809,514
30 Aug	1.00	1.00	1.00	-	0.98	1.00	0.96	0.99	3,834,700
31 Aug	1.00	1.00	1.00	-	1.00	1.00	1.00	1.00	3,866,754

Note: Estimates for fall chum, coho salmon and other species are considered conservative and may not include the entire run.

APPENDIX G

Appendix G1.–Pilot Station sonar project passage estimates, 1995, 1997–2007.

	2007			2006	2005 [a]	2004	2003	2002	2001[b]	2000	1999	1998	1997 [c]	1995
Species	Passage Estimate	lower 90% Confidence Interval	upper 90% Confidence Interval	Passage Estimates										
Large Chinook [d]	90,184	72,563	107,805	145,553	142,007	110,236	245,037	92,584	85,511	39,233	127,809	71,177	118,121	130,271
Small Chinook	35,369	25,574	45,164	23,850	17,434	46,370	23,500	30,629	13,892	5,195	16,914	16,675	77,526	32,674
Chinook Total	125,553	113,298	137,808	169,403	159,441	156,606	268,537	123,213	99,403	44,428	144,723	87,852	195,647	162,945
Summer Chum	1,726,885	1,638,554	1,815,216	3,767,044	2,439,616	1,357,826	1,168,518	1,088,463	441,450	456,271	973,708	826,385	1,415,641	3,556,445
Fall Chum [e]	684,011	636,566	731,456	790,563	1,813,589	594,060	889,778	326,858	376,182	247,935	379,493	372,927	506,621	1,053,245
Chum Total	2,410,896	2,349,944	2,471,848	4,557,607	4,253,205	1,951,886	2,058,296	1,415,321	817,632	704,206	1,353,201	1,199,312	1,922,262	4,609,690
Coho [e]	173,289	152,549	194,029	131,919	184,718	188,350	269,081	122,566	137,769	175,421	62,521	136,906	104,343	101,806
Pink	71,699	51,944	91,454	115,624	37,932	243,375	4,656	64,891	665	35,501	1,801	66,751	2,379	24,604
Other Species [f]	1,085,316	1,002,153	1,168,479	875,899	593,248	637,257	502,878	557,779	353,431	361,222	465,515	277,566	621,857	1,011,855
Season Total	3,866,753			5,850,452	5,228,544	3,177,474	3,103,448	2,283,770	1,408,900	1,320,778	2,027,761	1,768,387	2,846,488	5,910,900

Note: Estimates for all years were generated with the most current apportionment model and may differ from earlier estimates.

[a] Estimates include extrapolations for the dates June 10 to June 18, 2005 to account for the time before the DIDSON was deployed.

[b] Record high water levels were experienced at Pilot Station in 2001, and therefore passage estimates are considered conservative.

[c] The Yukon River sonar project did not operate at full capacity in 1996 and therefore there are no passage estimates.

[d] Chinook salmon >655 mm.

[e] This estimate may not include the entire run.

[f] Includes sockeye salmon, cisco, whitefish, sheefish, burbot, suckers, Dolly Varden, and northern pike.

APPENDIX H

Appendix H1.–Percentage agreement of passage estimates produced using the standard 3-3 hour sampling method with those produced during continuous 24 hour sonar periods, by zone from 1998 to 2007.

	% Agreement [a]			
Date of 24-hr sonar period	Right Bank	Left Bank Nearshore	Left Bank Offshore	Total Daily Passage Estimate
06/18/98	0.146	-0.030	0.111	0.049
07/02/98	0.056	-0.056	-0.018	-0.007
07/04/98	0.012	-0.059	-0.075	-0.030
07/05/98	-0.118	-0.042	0.171	-0.048
07/06/98	-0.150	-0.041	-0.221	-0.114
07/16/98	-0.053	0.052	-0.109	-0.008
07/17/98	-0.053	0.052	-0.109	-0.008
08/10/98	0.062	0.125	0.000	0.065
08/24/98	-0.085	0.283	-0.013	0.132
06/26/99	-0.169	0.129	-0.175	-0.040
07/11/99	-0.123	0.024	0.110	0.031
07/24/99	-0.028	0.088	-0.062	0.012
08/08/99	-0.028	0.088	-0.062	0.012
08/21/99	0.059	0.300	0.075	0.170
06/28/00	-0.091	0.176	-0.007	-0.014
06/29/00	-0.040	0.110	0.015	0.040
07/12/00	-0.258	0.105	0.003	-0.015
07/26/00	-0.258	0.105	0.003	-0.015
08/16/00	0.091	0.165	0.143	0.143
08/30/00	-0.007	0.083	-0.092	0.030
07/03/01	-0.026	0.143	-0.136	0.024
07/20/01	-0.042	0.156	0.048	0.084
08/06/01	-0.037	-0.068	-0.050	-0.054
08/19/01	-0.062	0.022	-0.052	-0.040
06/17/02	0.165	-0.001	-0.049	0.016
07/02/02	-0.140	0.016	-0.025	-0.038
07/17/02	-0.099	0.109	0.039	0.005
07/31/02	-0.046	0.004	-0.176	-0.103
08/16/02	-0.050	0.090	0.095	0.047
06/22/03	-0.148	0.337	-0.087	0.030
07/06/03	-0.066	0.060	0.065	0.043
07/21/03	-0.005	0.182	-0.039	0.053
08/05/03	-0.011	0.475	0.261	0.279
08/18/03	-0.204	0.085	0.358	0.244
06/14/04	-0.232	0.198	0.114	-0.019
06/26/04	-0.039	0.234	-0.120	0.064
07/11/04	-0.066	0.072	-0.030	-0.010
07/25/04	-0.084	0.054	-0.005	0.013
08/08/04	-0.087	0.088	0.079	0.041
08/22/04	-0.195	0.092	0.323	0.155
06/18/05	0.006	0.184	0.003	0.053
06/30/05	0.041	0.058	-0.121	0.000
07/13/05	-0.001	0.002	-0.003	-0.001
07/27/05	-0.056	-0.002	-0.128	-0.052
08/09/05	-0.017	0.073	0.637	0.475
06/19/07	0.055	-0.003	-0.090	-0.032
08/05/07	-0.050	0.132	0.120	0.084

Note: A 24-hour sonar period was not conducted in 2006.

[a] Percentage agreement is derived as follows: (3-3 hour Total Passage Estimate/ 24 hour total passage estimate)-1. Therefore, a positive percentage indicates that the 3-3 hour estimate was higher than the estimate obtained during the 24-hour sonar period.